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THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

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HERBERT L. WHEELER, D.D.S., Sc.D., F.A.C.D., F.A.A.D.S.
(1869-1929)

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Original Communications

INFECTION OF THE MAXILLARY ANTRUM*

By GEORGE E. SHAMBAUGH, M.D., Chicago, Ill.

THE clinical problems arising from disease of the paranasal sinuses are foremost among those which interest the rhinologist. The maxillary sinus claims a major interest because it is more often the seat of those conditions which require special local or surgical treatment than are any of the other sinuses. The greater frequency of antrum infection appears to be due not so much to the fact that this sinus alone of all the paranasal sinuses may be infected by extension from disease about the upper molar teeth, but to depend on other factors, such as the much larger size of the antrum cavity and its poorer facilities for drainage. The rhinologist has found that antrum infection of dental origin is rare when compared with infections arising from extension of disease from the nasal passages.

I shall not discuss the ordinary symptoms which annoy the patient suffering from an acute or chronic maxillary sinusitis, but shall discuss briefly some of the problems that have arisen concerning antrum infection. There are those who attribute to chronic sinusitis, even the latent type causing no local symptoms, a very important rôle in producing an unusual susceptibility to head colds, acute and chronic bronchitis, bronchiectasis and nasopharyngeal catarrhs, as well as the systemic disturbances suspected to be of focal origin.

So many and varied are the disorders attributed to sinusitis that one should possess a considerable background in clinical experience if he would avoid the risk of subscribing to propositions that have no real foundation in fact. There are certain diseases of the sinuses which give rise to symptoms closely resembling those of a recurring head cold. An active antrum infection, for example, will produse an increased nasal discharge and swelling of the nasal mucosa with obstruction to nasal respiration. Again, the condition known as hyperplastic ethmoi-

*Read before the Section on Oral Surgery at the Midwinter Clinic of the Chicago Dental Society, Jan. 15, 1929.

ditis gives rise to symptoms often mistaken for those of an acute head cold by the patient and by the physician as well: sneezing attacks, intermittent swelling of the nasal mucosa, and obstruction to nasal respiration associated with attacks of profuse nasal discharge. The cure of sinusitis, or the hyperplastic ethmoiditis, relieves the patient of these symptoms, and it is easily seen how a false conclusion is reached that these conditions in the sinuses render the patient susceptible to head colds, when, as a matter of fact, it was not head colds at all from which the patients were suffering. I have not been able to discover that a patient with chronic sinusitis seemed to be unusually susceptible to head colds or bronchial infections. On the contrary, I have sometimes been led to suspect that the presence of a chronic sinusitis is prone to lead to an immunity for just those acute infections in the respiratory tract which some would have us believe result from the presence of the chronic sinus infection.

An acute infection which begins in the nasal mucosa frequently extends to the paranasal sinuses and at the same time may involve the bronchi. Therefore, that chronic bronchitis or bronchiectasis should occasionally occur is exactly what one should expect in patients who have at the same time a chronic sinus disease, since the two conditions have had a common origin in the acute nasopharyngitis. It would seem to me a debatable question whether the bronchial trouble, and eventually perhaps a bronchiectasis or a pneumonia, are in any way dependent on the sinus infection, or whether the sinus disease may not be prolonged because of the effect on the general condition produced by the chest complications. As a matter of fact, most cases of chronic bronchitis are not associated with chronic sinus disease, and most patients with chronic sinus infection are not troubled with bronchial disturbances.

The assumption that chronic postnasal catarrh is a characteristic symptom of chronic sinusitis is not well founded. Postnasal catarrh is rarely found to be a conspicuous symptom in chronic antrum infection, or indeed of infection in any of the paranasal sinuses. It is a conspicuous symptom in many patients suffering from alterations in the nasal passages, such as persist, for example, after removal of the lower turbinal bodies. Chronic alterations in the nasal mucosa, especially when there is any tendency to atrophy, are the usual cause for most cases of postnasal catarrh.

Regarding the question of sinus disease as a focus for systemic infection, I am of the conviction that chronic sinus disease is a much less important factor in producing systemic infection than are either the teeth or the tonsils. A demonstrable sinus infection occurring in connection with systemic disease appears to be extremely rare. I have been interested in the problems of focal infection since these studies first began, but I have seen few patients in whom there appeared to be any justifiable suspicion that sinusitis was a possible factor in producing systemic disease. It is quite in keeping with the rather loose thinking indulged in today concerning focal infection to assume that even when there is no demonstrable sinus infection there may still be present some intangible undiagnosable sinus condition which constitutes a focus for systemic disorders. I have heard seriously discussed the advisability of urging operative procedures in just such situations as this.

Another illustration of the unwarranted manner in which troubles are attributed to the sinuses is in the question of headaches. It appears that because pain in the head may be a conspicuous symp-

tom in some few cases of sinusitis, there has been an increasing tendency in recent years, when no palpable cause for this symptom is apparent, for the physician to assume that the headache must be due to sinus disease, and even when a careful search fails to reveal any evidence of such disease in the sinuses, it is still claimed that the headaches must be of sinus origin, the presence even of a supposed vacuum produced in the sinus through faulty ventilation being assumed. There seems to be a tendency here to overlook the clinical fact that most cases of sinus disease never produce the symptom of headache, and most patients suffering from headaches do not have sinus disease. I am constantly encountering patients who have had extensive operations on the sinuses for the cure of headaches, although there is nothing in the history or in the local findings which suggests that there ever has been sinus disease, and the headache is palpably an ordinary migraine.

Concerning the clinical problems of acute sinus infection, there is, on the whole, little difference of opinion. The rhinologist finds that most of the acute processes develop in connection with an acute rhinitis. It is not surprising, when we consider the great frequency of acute infection involving the nasal mucosa, to find the nasal sinuses so frequently affected by an extension of inflammation from the nose. The dental surgeon, on the other hand, whose attention to antrum infection is limited to cases which develop secondary to dental trouble, may easily be led to believe that dental trouble is the usual cause for antrum disease. Occasionally, the dentist, when extracting an upper molar, discovers that the floor of the antrum has been broken through in the process of extraction. This mishap is not one that could necessarily have been avoided by any amount of care, nor is it likely to be a serious matter. If there is no infection about the dental roots, an infection of the antrum is not likely to occur, provided the condition is left quite alone and no efforts are made either to probe the sinus or to irrigate the cavity. A more unusual mishap occurs when the loosened molar is lost in the sinus. This accident should not be taken too seriously. It hardly warrants undertaking an operation to salvage the lost tooth unless a reaction occurs, for a loose tooth in the cavity of the antrum cannot be the source of any serious trouble. It is not likely to be a factor either in producing or in prolonging sinus infection.

The principles which underlie the proper treatment of acute sinusitis are, for the most part, quite the same whether the antrum trouble develops secondary to dental disease or is of nasal origin. The outstanding factor in the proper treatment of antrum infection is to secure proper ventilation and drainage of the sinus. If the drainage through the normal opening is not rendered more difficult because of anatomic irregularities in the nasal passages, the local treatment which is proper for the care of acute rhinitis is usually quite sufficient to bring about a cure of the sinus infection. This treatment consists of cleansing the nasal passages and applying astringents, such as ephedrin or a weak solution of cocain, along the opening into the middle meatus. When adequate ventilation and drainage through the normal opening can be established in this way, an acute antrum infection will subside usually about as promptly as does the acute rhinitis. If there is a tendency for the infection in the sinus to be prolonged, simple irrigation by puncturing through the nasal wall will usually clear up the process quite promptly. If lavage of the sinus does not

effect a prompt cure, that is, after a few days or a few weeks at most, one should consider the question of securing proper drainage by making a permanent opening into the sinus, either in the middle meatus or under the inferior turbinal body. It is usually necessary to resort to this method if anatomic irregularities in the nose interfere with ventilation and drainage through the normal opening. In those exceptional cases in which the sinusitis results from an extension of a dental infection, it is, of course, important that the dental condition receive proper care. I would emphasize that, in the proper treatment of an acute antrum infection, there is rarely, if indeed ever, an indication for radical surgical measures.

The clinical problems of chronic antrum infection are more difficult, and, as we might expect, there are differences of opinion regarding the etiology of the chronic cases, and the diagnosis, as well as the clinical significance of some of the conditions; and particularly there are differences of opinion as to the proper management of treatment.

In connection with the etiology of antrum infection, we should remember that the antrum often represents a larger cavity than the entire space included in all of the other paranasal sinuses, that the natural opening is placed close to the top of the cavity and that, on its nasal aspect, the opening is covered by the middle turbinal body. When we add to these anatomic relations the frequent occurrence of anatomic irregularities, such as a deflection of the nasal septum, in which it crowds the middle turbinal body tightly against the outer nasal wall, it becomes clear that adequate ventilation and drainage of the antrum is at best rather precarious, and one can readily understand why acute antrum infection, especially when treatment is neglected, may often be prolonged until permanent alterations develop in the lining membranes; which makes the process one of chronic sinusitis. An apical infection about the upper molar teeth which breaks through into the cavity of the antrum is palpably the cause for some of these chronic antrum infections, and there are those who have suspected that an apical infection which has not broken through into the antrum might still be a factor in the etiology of chronic antrum disease, supposedly through lymphatic drainage.

By chronic sinusitis, we understand the development of permanent changes in the membrane lining the antrum. These permanent changes are usually the result of an acute inflammatory process which has become persistent, usually because of inadequate drainage and ventilation through the normal opening. Chronic sinus infection may also be produced through neglected apical disease. Some of these chronic alterations in the membranes lining the antrum are not the result of a persisting acute infection prolonged through faulty drainage; nor are they of dental origin. These are the cases in which there is a polypoid degeneration of the membranes lining the antrum quite like the condition of nasal polypi involving the nasal mucosa. Such cases are not associated with a purulent discharge except as they may become the seat of an intercurrent infection.

The ordinary case of chronic maxillary sinusitis is associated, at one time or another, with a pathologic discharge the character of which varies in different cases. At times, there is a gelatinous almost colorless clump of mucus washed from the sinus on irrigation. In others, the discharge is thick and mucopurulent. In still others, there is a thin cloudy exudate seen in the washings. Sometimes, there is an offensive odor. The pathologic

discharge may be persistent, with a tendency to continue indefinitely. It is not uncommon, in these chronic sinus infections, for the discharge to be intermittent, that is, quite absent when the process becomes latent, but again manifest when the inflammation is active, especially when an acute exacerbation follows in the wake of an acute rhinitis. Chronic maxillary sinusitis may be compared in many ways with chronic otitis media. In both conditions, the inflammation produces permanent changes in the membranes lining the cavities. In both, the discharge may be persistent or be present only during acute exacerbations and absent when the process becomes latent or quite exhausted. The condition is one of chronic sinusitis, or chronic otitis media, whether the process is active or is latent; that is, whether there is an active discharge or is no discharge.

The diagnosis of chronic maxillary sinusitis presents no particular difficulty with the aid we get from transillumination and the roentgenogram. Since the process is often unilateral, transillumination will usually show that one sinus lights up less clearly than the other. The roentgenogram in those cases in which, because of heaviness of the bones, transillumination is indefinite, will show any thickening of the sinus membranes. The injection of lipiodol into the cavity before the roentgenogram is taken makes it possible to diagnose somewhat more definitely the conditions in the antrum, especially the alterations in the mucosa, thickening and polyp formations; but there is little additional information obtained in this way that is of practical value in deciding what the treatment should be.

To determine whether the sinusitis represents an active or a latent process, that is, whether there is a pathologic exudate or not, requires something more than a roentgen-ray examination. The diagnosis of the presence or absence of secretions in the antrum is made by an examination of the washings after irrigation of the sinus. If transillumination or, as the case may be, the roentgenogram shows a shadow and the irrigation fluid comes through clear, it is very doubtful that the condition of chronic sinusitis responsible for the shadow has any serious clinical significance; for the annoyance to the patient and the possible menace as a focus of infection depend on the presence of a discharge. The situation might again be compared with that of chronic otitis media. No otologist thinks for a moment of advising operative measures in cases of chronic suppurative otitis media when the process is exhausted, that is, when there is no discharge, simply because his examination discloses a thickening in the membrane of the tympanum or altered pneumatization in the mastoid.

Why consider thickening of the membranes in the antrum as any more of a menace than the permanent alterations resulting from a chronic suppurative otitis media? The chronic maxillary sinusitis which calls for local treatment or operative measures is that form in which there is a persistent discharge. I emphasize this fact because, from some quarters one hears the question seriously discussed as to the diagnosis of a condition which is interpreted as a menace and in which radical surgical measures are advised, when the roentgenogram, with or without injections of lipiodol, demonstrates alterations in the membranes lining the antrum and, from the examination, there is no apparent discharge, but centrifuging reveals the presence of an occasional leukocyte in the washings. I can readily believe that, in the washings

from an entirely normal sinus, no cellular elements may be demonstrated even after centrifuging, but I am not prepared to believe that the presence of an occasional leukocyte, discovered after centrifuging the washings from irrigating the sinus, can really have any more clinical significance than would this same finding in an examination of the washings on irrigation of the nasal cavities. We see a sufficient number of cases of persistent discharge from the nasal mucosa in ordinary types of chronic rhinitis in which there are leukocytes aplenty. Why should we take the one situation more seriously than the other? I can see no justification for the conclusion that chronic infection of a sinus which is properly drained, and with the membranes left intact, is, in any way, more of a menace than is a chronic infection involving the nasal mucosa, in which we certainly would not recommend radical operative measures.

This question of refinements in establishing a diagnosis of chronic sinusitis when there is no demonstrable exudate seems to be largely the result of theories of focal infection and systemic disease. These theories have been responsible, as every one recognizes, for a widespread tendency to carry out indiscriminate surgical procedures. I need only to call attention to what is happening to the tonsils and the teeth. As a matter of fact, systemic infection in cases of chronic suppurative otitis media is practically unknown, and I suspect that systemic infection from chronic sinusitis is scarcely any more common than it is in chronic otitis media and perhaps no more so than one might expect from any chronic rhinitis or pharyngitis.

Most of the discussion covering sinusitis appearing in the textbooks, as well as in the current literature, concerns itself with matters of operative technic. It should be apparent that the proper handling of the clinical problems of chronic sinusitis calls for something more than a smattering of technic of operative procedures. Much more important are the ability to make a careful examination and a sufficient background in clinical experience to evaluate one's findings, and especially to acquire an appreciation of the proper indications for operative work.

As regards treatment of chronic sinusitis, I have already indicated that, for the latent antrum infection, that is, when there is no active discharge, no treatment, surgical or otherwise, is really called for. I realize that, in these days, when we hear so much about focal infection, there are those who are ready to believe that even those cases of exhausted chronic sinusitis, that is, cases in which the process is quite latent and there is no discharge, constitute a menace as a possible focus for systemic infection and that radical operative measures are justified. I believe that the treatment of chronic sinusitis should be reserved for those cases in which there is a persistence of discharge. These are the only cases which produce annoying symptoms and are the only ones, I believe, in which systemic infection may be a possible menace. Simple irrigation will often suffice for these cases, particularly for those in which the discharge consists of a clump of gelatinous mucus that can be flushed from the sinus. In conditions of this sort, I am of the belief that only an occasional flushing of the sinus is justified for the reason that this form of sinusitis is usually of no particular local annoyance to the patient, and as far as constituting a possible focus for systemic infection, seems to me to be palpably in the same category as that of any chronic nasopharyngitis, that is, a negligible condition. Why should we attach to the chronic sinusitis which is pro-

ducing a mucusy discharge possibilities for causing systemic infection that we do not consider in connection with the same sort of inflammation involving the nasal mucosa?

When there is a cloudy or a thick mucopurulent secretion washed from the sinus which does not clear up under simple irrigation, it is proper to proceed with surgical measures to affect a cure, for the reason that this sort of sinusitis is a source of annoyance to the patient, and possibly, though I suspect quite rarely, may constitute a focus for systemic infection. What now should be the aim of our surgical procedures? It is, I fear, not an uncommon error to assume that the more radical the operation, the better the end result is likely to be. As a matter of fact, the end to be obtained in these chronic cases is to establish adequate ventilation and drainage of the antrum. This is accomplished by securing a sufficiently large permanent opening into the nose; a result that can be reached, as a rule, quite as readily by an intranasal operation as by the more radical procedure of first removing the anterior wall of the antrum.

Those who advocate the so-called radical operation, such as the Luc-Caldwell procedure, are agreed as to the necessity, for the success of this operation, of an ample permanent opening into the nose. They are divided regarding the other question, as to whether the lining membranes of the antrum should be removed or left intact. I am of the belief that the important part of this operation is the securing of the permanent opening into the nose, and that it is doubtful that the removal of the mucoperiosteum of the sinus materially improves the condition. When these membranes are scraped out, they must be replaced by connective tissue which is even more removed from the normal lining of the sinus than is the thickened membrane which is the result of a sinusitis. The rhinologist experienced in the technic of intranasal surgery is able, in most instances, to secure exactly the same result as far as the opening into the antrum is concerned by an intranasal operation as that obtained by the Luc-Caldwell procedure. The latter method should, I feel, be reserved for those rather exceptional cases in which an intranasal operation cannot be successfully carried out, and for those surgeons who are inexperienced in intranasal work.

As regards the removal of pathologic conditions developing in the membrane lining the antrum, I am rather of the belief that it is about as logical to advise the exenteration of the membranes lining the nasal cavities when hypertrophied tissues appear in chronic rhinitis as it is to carry out the removal of the membranes lining the antrum for the same pathologic conditions. In the nose, we do excise hypertrophic tissue, but only when its presence produces local symptoms, not because its removal cures the chronic rhinitis. The presence of hypertrophied membranes in the sinus does not produce local symptoms, and with the window resection establishing proper ventilation and drainage into the nose, the antrum is left in exactly as good a condition as persists in any ordinary chronic rhinitis.

This brings up the question of what constitutes a cure in these cases of chronic sinusitis. If we are looking for a return to the normal of the conditions within the sinus, there are, I suspect, very few, if indeed any, of these cases which are ever quite cured. Even when the exenteration of the lining membranes of the sinus has been carried out, there cannot be a return to the normal. Evidences of thickening of the lining membrane can usually be demonstrated indefinitely by transillumi-

nation and particularly by the roentgenogram. For all practical purposes, we should consider a case of chronic sinusitis as cured when an operation for establishing proper ventilation and drainage into the nose has been successfully accomplished. With such an opening into the nose, the symptoms which have annoyed the patient will usually disappear, because, in most instances, there will be a practical cessation of discharge. In others, there may persist a condition similar to that which persists in the membranes lining the nasal cavities in some cases of chronic rhinitis, that is, a condition which, for the comfort of the patient, may require an occasional simple irrigation, which the patient may very well carry out for himself. The situation in chronic sinusitis in this condition is quite comparable to that of a simple chronic suppurative otitis media without a bone invasion, with a permanent opening in the drum membrane.

In the antrum as well as in the middle ear, one may expect an occasional exacerbation from a fresh infection associated with the occurrence of an acute rhinitis. No type of operation on the antrum is going to prevent possible recurrences of this sort any more than one could prevent the occurrence of an acute infection of the membranes of the nose or pharynx. With the antrum well drained, I can see no justification for attaching any more clinical significance to an infection of the upper respiratory tract which includes an extension to a well ventilated antrum than that which we attach to the inflammation of the nasal mucosa. In the treatment of a chronic antrum infection, the aim should be to relieve the patient of the annoyance caused by the persistent discharge. This is accomplished when we have succeeded in providing a sufficiently large permanent opening between the antrum and the nasal passages. With this accomplished, we have also done as much as is usually possible in the matter of removing a potential focus for systemic infection.

From the discussions which appear in the literature, one gets the impression that quite too much emphasis is being placed on the recognition by means of the roentgenogram, with or without the use of lipiodol, of the conditions constituting pathologic thickening of the membrane lining the antrum, with the assumption that these alterations in themselves constitute indications for radical surgical measures. Are we not sometimes failing to recognize that the aim in the treatment of these patients is primarily to relieve them from annoying symptoms and, at the same time, to remove a possible source for systemic disturbances? The aim is not to attempt to restore normal membranes in the sinus by the removal of the altered mucosa, for we know this cannot be done. When we carry out an exenteration of the thickened mucosa from the antrum which has not been responsible either for local symptoms or any general disturbances, it is not apparent that we have rendered any particular service to the patient.

What would we say of the rhinologist who advocates surgical measures in the treatment of chronic rhinitis because palpable alterations in the nasal mucosa are demonstrable, but which were not producing any symptoms that could in any way be relieved by these operations? We should consider him perniciously meddlesome. Does not the same approbrium apply to the rhinologist who advocates radical surgical measures for exactly the same conditions when they develop in the maxillary sinus, and when they are not responsible for any local symptoms, and can scarcely be consid-

ered of any more consequence in producing systemic infection than are the chronic alterations in the mucosa of the nose and pharynx in any ordinary chronic nasopharyngitis?

In closing, I would point out that, while a physician should always be alert to do everything possible to relieve a patient from annoying symptoms, or from conditions which may constitute a serious menace, he should also be just as anxious to avoid doing things that are unnecessary, especially when they include operative measures which in themselves are a hazard.

DENTAL DECAY—WHAT IT IS AND MEANS FOR ITS CONTROL*

By HAROLD F. HAWKINS, D.D.S., Los Angeles, Calif.

DENTAL decay is the molecular disintegration of the hard substance of the teeth, by unneutralized acids of fermentation, due to a lack of basic or acid neutralizing salts in the saliva.

The acid fermentation theory of W. D. Miller rests upon solid ground, and as far as that theory goes, it is a complete explanation of the factors involved in the molecular breakdown of the tooth, in tooth decay. A great many of the experiments on the enamel which were performed by Miller have been duplicated at the College of Dentistry, University of Southern California, and in no essential detail have we found any serious discrepancy.

We have found that any fermentable carbohydrate producing a concentration of acid of p_H 4.3 or greater, maintained for two weeks, is able to remove the intercementing substance of the enamel of a tooth and that its removal can readily be detected on drying.

The density of the intercementing or interprismatic substance of the enamel has been seen to vary considerably in different teeth. In mouths showing many active carious lesions, the intercementing substance is very much less dense than in teeth from immune mouths.

This can be easily shown to be true by grinding with a stone through the enamel to the dentin of two teeth, one from a carious mouth and one from an immune mouth, and then subjecting these teeth to weak acid for a few days. If they are removed each day for observation and allowed to dry, it will be seen that the etching effect on the ground area is more rapid on the teeth from carious mouths, and also that the etching is usually more intense at the surface of the enamel than near the dentino-enamel junction. On the enamel of the immune teeth, the intensity of the etched surface is often greatest at or near the dentino-enamel junction. This has been interpreted to indicate that, where the concentration of acid is great enough in and about the teeth, it is able to dissolve the interprismatic substance of the

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 23, 1928.

enamel, reducing its density throughout, but to a greater degree near the surface; while in immune mouths, owing to a suitable reaction, the calcium content of the saliva was precipitated in the intercementing substance, producing increased hardness of this tissue, especially near the periphery.

eruption is vastly more important than any prenatal factors in determining the hardness of this structure.

To illustrate this point: A pure blooded native Hawaiian was born and reared on one of the islands remote from that on which Honolulu is located. He wore little clothing, and he had a fine

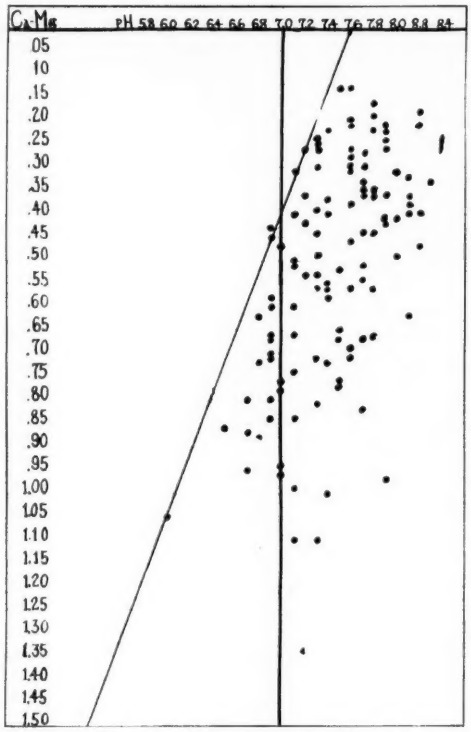

Fig. 1.—Immunity to decay.

If the interprismatic substance that supports the enamel rods can be increased or decreased in density according to the environment or composition of the saliva that surrounds the teeth, while not minimizing the importance of prenatal factors, this would seem to imply that the environment of the teeth after

physique and exceptionally beautiful teeth. His diet was raw fish, poi, white potatoes and a considerable amount of fruit and vegetables, but he ate no cereals of any kind and no sweets. He went to Honolulu, adopted a diet which contained a considerable amount of cereals, pastry and sweets. In three months, he

was in the dental chair with several cavities.

Several other cases quite on a par with the foregoing have convinced us that no matter how hard the teeth may be, they cannot long resist the wrong oral environment.

Can the saliva become acid enough of itself to decalcify the teeth? The evidence is very strongly against it. McClelland has performed a series of experiments on teeth covering a period of six months. In that time, no teeth showed any change unless the concentration of acid was greater than p_H 6.0. We have performed several thousand salivary tests and have found no mouths with a greater acidity than p_H 6.0 (colorimetric).

Our experiments on starch and sugars show their p_H values to be from +.5 to 3.3. At an acidity greater than p_H +.0, the interprismatic substance is removed very rapidly and the enamel of teeth is etched white in a comparatively few days. Carbohydrates are without doubt the only class of foods that can produce a local concentration of acid sufficient to cause rapid decalcification of the teeth.

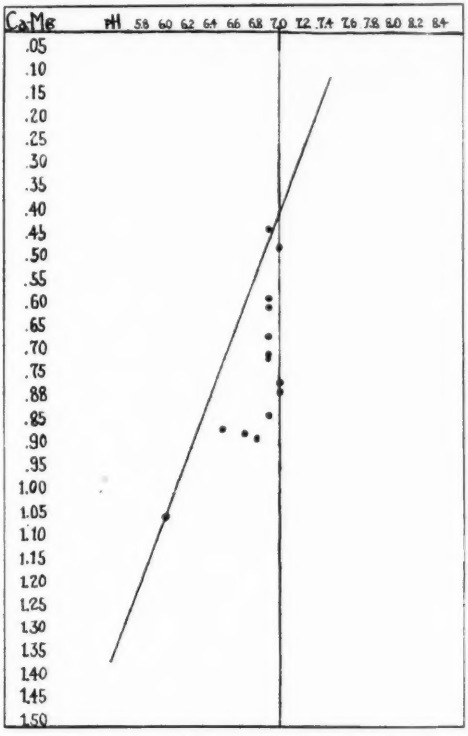

Fig. 2.—Immunity to decay, with pyorrhea.

The organism or organisms involved in this local fermentation is of only academic importance. The character of

the bacteriologic flora of the mouth is largely dependent on the reaction of the saliva and the character of the food on which the bacteria are feeding. The fact that bacteria are able to break down carbohydrates to a concentration of acidity sufficient to cause decalcification is the all-important fact.

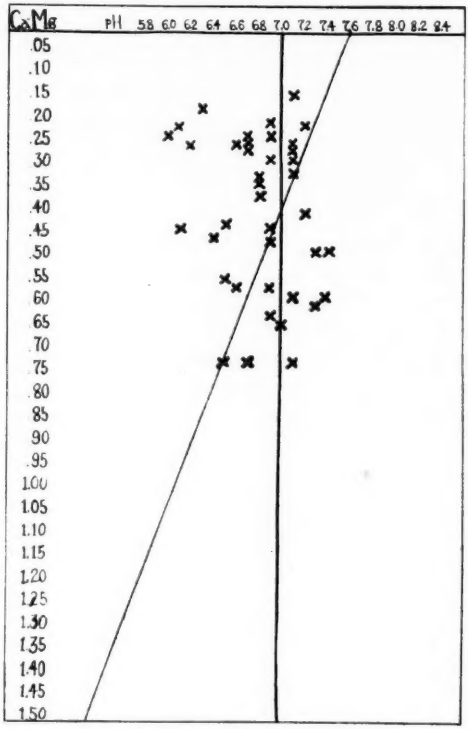

Fig. 3.—Active decay.

In the test tube, any carbohydrate that is able to produce a concentration of acid sufficient to decalcify the teeth might be considered a possible factor in tooth decay. Does this hold good in the mouth? We think not.

If we analyze the diets of the world, we find that the wheat-eating people have more trouble with tooth decay than the corn-eating races. In the United States, the corn-eating districts have a higher percentage of immune individuals than the wheat-eating sections. In general, the heavy cereal-eating races show a greater incidence of dental decay than people with a small or low cereal consumption. We have yet to find a race of people who do not consume cereals of some type and who have any caries whatsoever. The term "cereal" is used in its broadest sense, referring to any of the cereal grains and products made from wheat, corn, oats, rye and rice.

The Eskimos, a noncereal eating race,

on their native diet are entirely immune to decay. The South Sea Islanders, another noncereal eating people, are also entirely free from dental decay. I quote Gustaf Bergfors, University of Upsala, Sweden, who has recently made extensive researches in the South Seas:

> The people are a noncereal or nongrain eating people, probably more than 50 per cent of their diet consisting of raw fish. The vegetables used are usually of the root type, such as taro root, and are cooked. Few leafy vegetables are consumed. The fruit used is principally eaten raw with the exception of bananas, which are cooked. While goats are found on some of the islands, the milk is not used for food. The reaction of the salivas of the natives is decidedly acid. There was no incident of decay among these people, but there was a pronounced tendency to pyorrhea.

What is there about cereals, and especially wheat, that might make this class of foods more dangerous than other carbohydrates, such as potatoes? We believe it is largely its gluten content. We have never been able to produce the white scum or white gelatinous food plaque by any class of foods except the cereals.

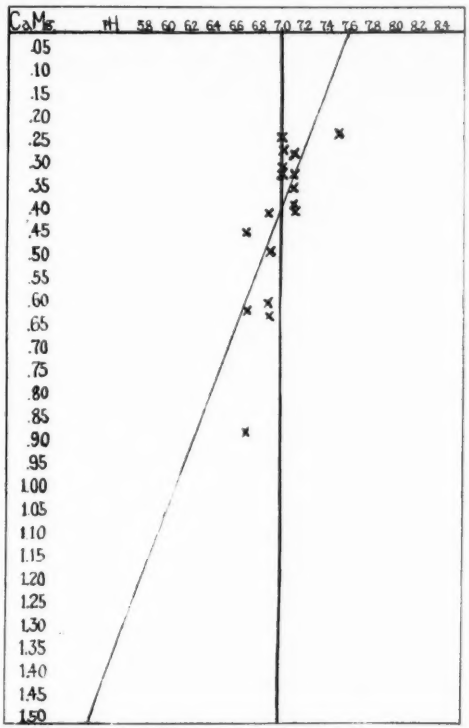

Fig. 4.—Erosion and class V cavities.

We have separated crude gluten from white flour and cooked gluten from white bread, and tested their solubility by the action of dilute lactic acid. We

have found that there is no change apparent to the eye in gluten at less than p_H 5.0 (lactic acid); and at that concentration, only slight swelling occurs. It is only when near p_H 3.0 that gluten assumes a colloidal form and disintegrates. Our records to date show that the salivary range of salivas is between p_H 6.0 and p_H 8.4 (colorimetric). Within this range, gluten cooked or raw to the teeth, it is readily removed by the saliva.

Cereals vary as to their gluten content. Wheat, without doubt, carries the largest percentage. For that reason, we consider it the most objectionable. Corn is much lower in gluten.

Cereals as a class are low in calcium. They also have a high magnesium content, which has been found by Steen-

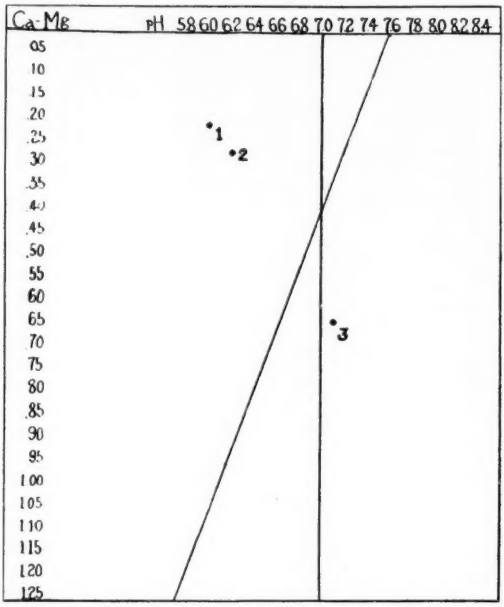

Fig. 5.—Effect of well-balanced diet on active decay. The diet was alkaline and rich in calcium and vitamins A and B.

does not appear to be seriously broken down. On account of its sticky or glue-like consistency, it sticks to the teeth and holds with it the incorporated starch granules. The starch is acted on by the bacteria and broken down to lactic acid while being held in direct contact with the teeth. As the starch from the root type of vegetables does not tend to stick

bock and others to have an inhibiting action on calcium metabolism. Cereals also have an adverse effect on elimination through the kidneys; which will be discussed under another heading.

All evidence points to the fact that people suffering from dental decay are not susceptible all the time. Active cavities which are white or pinkish turn

dark and cease to be active—the so-called "arrested cavities." At other periods, they become active again, with a further break down.

We were therefore driven to a study of the reactions of the immune, believing that, as a class, they must be fairly uniform in maintaining a suitable reaction about the teeth or otherwise, caries would quickly follow. This surmise was correct, as will be seen by the chart covering this class.

The acidity and alkalinity of the saliva were determined by the hydrogen ion concentration method (colorimetric). The calcium determinations were made by the method recommended for blood by Mathews (Kramer and Tisdall). (Care must be used in the selection of ammonium oxalate for this test, some of the chemically pure salt being unable to precipitate the calcium properly.)

In comparing the colorimetric hydrogen ion test with the potentiometer or electrical method, we find the two methods are in close agreement on urine when read at once. When the specimen is allowed to stand for one hour, the colorimetric method shows a slightly more alkaline condition. The test on saliva is not so closely in accord. The initial reading by the colorimetric method is more acid; the final reading, more alkaline.

We have interpreted these differences as follows on solutions such as saliva. The initial reading on the potentiometer is probably a more accurate measure of the actual free hydrogen ions of the solution than that afforded by the colorim-

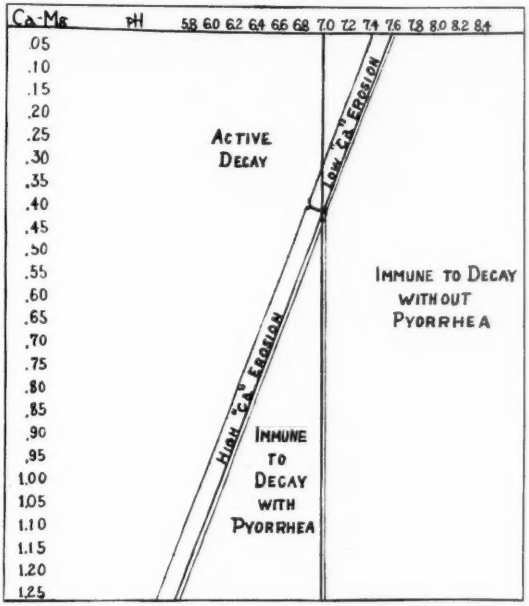

Fig. 6.—Relationship of active decay, erosion and pyorrhea to immunity.

etric method. On account of the viscosity of saliva, probably due to mucin, the indicators used in the colorimetric test take some time to mix with the solution, and until mixing is complete, it appears to be more acid than its true p_H reading. If the solution has a buffer action, more ions will become available in the solution as those available combine with the indicator. This will continue until all possible ionizable ions have acted on the indicator. Also, carbon dioxid gas is being liberated, which contributes to the alkalinity. At the end of an hour, it usually reaches an end point. Hence, it would appear that the colorimetric method with solutions such as saliva, if results are read at the end of an hour, is rather a registry of the hydroxyl ions available for neutralization than of those that are actually free in solution. In determining the neutralizing value of saliva, it would seem that the colorimetric method is superior, in the work at hand, to the electrical method.

Urine, not being viscous, gives a true initial p_H reading with the colorimetric method. On standing, the passing off of carbon dioxid gas tends to make the reading more alkaline. However, urine has a distinct buffer action. If the urine is acid, more hydrogen ions are available to combine with the indicator; which tends to increase the indicated acidity. We find that at p_H 5.0, the loss of carbon dioxid gas and buffer action tend to offset each other, and there is usually no rise. When the urine is alkaline the picture is different. The initial reading is probably the true p_H. When the specimen is al-

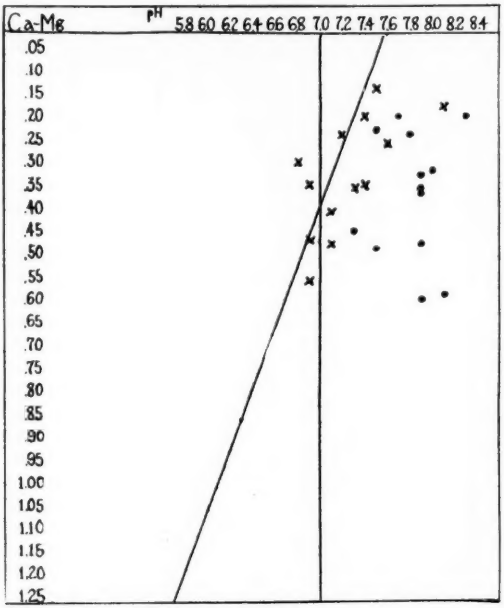

Fig. 7.—Effect of orange juice and cod-liver oil on group of children.

lowed to stand, carbon dioxid gas is given off, which moves the reading toward the alkaline. The buffer action, which is now due to hydroxyl ions, combines with the indicator and moves the reading still farther toward the alkaline. This is confirmed by the tendency of alkaline urine to move strongly toward the alkaline on standing. Acid urine does not tend to do this, having a very limited change, usually none at all when quite acid.

In securing a sample of saliva, it is important to obtain active saliva, not resting saliva. We are attempting to measure the neutralizing value of the saliva, if it possesses any. This we can do by demanding a quantity sufficient to guarantee that it comes from the glands. It is important that at least one hour elapse after eating before a specimen is obtained and that no exercise be taken for a considerable length of time, or results will be erroneous.

It is important with the colorimetric method that readings be made at the end of an hour. The more alkaline the saliva, as a rule, the greater the change on standing, and, conversely, the more acid, the less change shown. At p_H 6.0, there is usually no change.

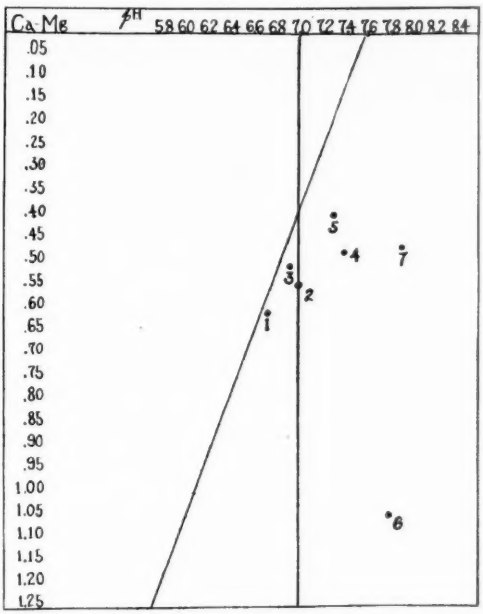

Fig. 8.—Effect of alkaline diet on erosion.

We believe that the p_H reading at the end of an hour is very near to the true neutralizing value of the saliva. In examining the graphs, remember that p_H 7.0 is neutral; any number greater than this indicates alkalinity and any number less than this, acidity. The calcium content is rated in milligrams per cubic centimeter of saliva.

Figure 1 shows results in more than 100 individuals who are immune to decay. No one represented on this tabulation ever had a cavity of decay. The graph therefore shows the reactions of immune individuals. A dot on the graph indicates the p_H value and calcium content of that person. It is charted by locating that person's p_H value at the top of the graph and descending vertically to a point opposite the calcium content.

All the dots are on the alkaline side of neutrality with the exception of those that represent high calcium values, some of which are quite acid. We believe that all values well to the right, or toward the alkaline, are for individuals with a liberal margin of safety; while those to the left, either on or near a line drawn diagonally across the graph, are borderline cases; that is, their margin of safety is very slight or is nil.

It appears from this chart that an individual obtains his immunity from the alkaline content of saliva and from the calcium content, either one acting as a neutralizer of the acids of fermentation. The greater the calcium content of the saliva, the less the alkalinity necessary for immunity. As a general statement, all values to the left of the diagonal line, which was obtained from borderline cases, show susceptibility to caries; that is, any individual whose saliva the alkalinity and calcium content of which places it well to the left of this line is subject to dental decay.

We do not consider this diagonal line as other than a rough approximation of a dividing line between immunity and decay, as the tabulation represents only about 100 persons that were immune. After we have 500 or more, we shall probably be much nearer to a correct line of division. We also believe that it is absolutely impossible ever to establish a definite line, no matter how many cases are piled up, because we are dealing with three factors, two of which can probably be measured accurately; one, probably never.

The neutralizing value of the saliva can probably be accurately measured by p_H values and calcium content, but whether an individual will be immune or not at a definite point of alkalinity and calcium content depends on the amount of the acids of fermentation to be neutralized. This varies with the amount of carbohydrate food pabulum remaining in the mouth after a meal. Mouths vary as to this residual fermentable pabulum. Persons with clean mouths will not need the neutralizing value that a dirty mouth will require for immunity. Hence, it is absolutely not possible ever to establish a hard and fixed line that will apply to all people. We can establish a zone or an approximate line that will cover most cases.

Figure 2 covers persons suffering from active pyorrhea who were immune to decay. They lie on the acid side of the neutral line and to the right of the diagonal line. The subject of pyorrhea will be discussed at greater length under an appropriate heading.

Figure 3 covers individuals suffering from active decay. As far as clinical judgment was possible, each at the time of test showed active caries. We tried to secure cases with many apparently active cavities. Cases showing evidence of arrested caries were rejected. Most of the cases, as will be seen, are on the acid side of the diagonal line. In spite of careful selection, a percentage were immune, that is, on the immune side of the diagonal line.

As we have believed for some time, a great percentage of individuals who suffer from caries are susceptible only a

part of the time; that is, caries will be active for a while, then be arrested, and, at a later time, again become active. Hundreds of cases have convinced us that caries is usually rampant in winter and early spring, very seldom so in summer.

After a cavity is of a size to retain quite a little fermentable food, that area may be in a state of activity, while the rest of the mouth remains immune. Nearly all mouths seem to have areas where food will lie or pack in quantity. These may be areas of open or flat contact, deep pits or fissures, or receded gums which make a place for food retention. Such areas will be in a state of slow caries, while the rest of the mouth will be immune. This applies only in cases in which the safety factor of the individual is too low. By this term safety factor, we mean that the alkalinity or calcium content is not sufficiently high to give a good margin of immunity. Observation has convinced us that mouths lacking in oral hygiene which are immune have a very high safety factor, while most of the borderline cases that are immune have well cared for mouths.

Figure 4 covers erosion and Class V cases. As will be seen, they are strictly borderline. In true erosion, there is a relatively high calcium content with an acid saliva, but cases showing low alkalinity and low calcium content are common. The reaction and calcium content of these specimens of saliva are not favorable enough to secure immunity or poor enough to invite active decay.

We note that erosion is usually found in clean mouths, while typical Class V cavities are found primarily in mouths lacking oral care. We believe that the principal differences between Class V cavities and erosion arise from the presence of coarse abrasives in tooth paste and improper tooth brushing; that is, the decalcified enamel and dentin of a Class V cavity is polished and removed by abrasive pastes and improper brushing as well as by coarse gritty foods and articles containing fine sandlike chewing tobacco.

Before making any dietary changes in cases of active decay and erosion, it is essential that a suitable urinalysis be made. If the kidneys are failing to eliminate acid salts, compelling the salivary glands to assume this function, little progress can be made in correcting the condition until the cause of this failure is ascertained and corrected. A study of the calcium loss and reaction of the urine is very important.

Considerable calcium is often lost through the urine; at times, a greater quantity per cubic centimeter than through the saliva. In healthy immune individuals, the loss through the urine is usually low, unless the person is of a certain endocrine type.

A great many urine tests have developed the fact that the loss of calcium varies not so much with the quantity of liquid passed as with the reaction of the specimen. The more alkaline the urine, the greater the calcium loss through this channel. The more acid the urine, the less such loss in the same individual. It is important, therefore, to maintain a fairly acid urine. In making tests on the urine, it is important that the subject avoid exercise, as that temporarily increases the acidity of the urine as well as the calcium loss. Tests made every hour on a series of individuals show that the urine tends to be the most acid one-half hour after eating a meal. The concentration of the acid tends to decrease as it approaches the next meal. This normal change should be taken into con-

sideration. The time of day that a specimen of urine is taken is of great importance. The before-breakfast specimen is average and therefore a good one for analysis.

Immune individuals on a mixed diet tend to have an alkaline saliva and quite an acid urine, especially soon after a meal; and, before the next meal, the urine seldom reaches the neutral point. Individuals who have pronouncedly acid mouths and an alkaline urine have impaired elimination through the kidneys. This may be due to diseased kidneys or to focal infection, as from infected teeth or pyorrhea pockets, or may arise from the consumption of a high cereal diet.

TABLE 1—SALIVARY AND URINARY REACTIONS IN INDIVIDUALS IMMUNE AND NONIMMUNE TO CARIES

Immune to Decay	
Saliva p_H	Urine p_H
7.8	5.1
7.4	5.6
7.1	5.2
7.0	5.2
6.8	5.1
Active Decay (High Cereal Diet)	
Saliva p_H	Urine p_H
7.2	7.3
7.1	8.0
7.1	7.4
6.7	7.8
6.1	8.1

It has been noted time and time again that, when the cereal intake is very high over a considerable period of time, the urine tends to become alkaline, with a heavy calcium loss, and the saliva acid, with a reduced calcium content. Cereals, besides their local acid fermentative action, appear to have a toxic action on the kidneys, impairing elimination through that channel and thus causing the saliva to assume the burden of elimination of acid salts..

While an acid urine means a decreased calcium loss through the kidneys, an acid saliva means an increased loss. The more acid a saliva is, the greater the calcium spillage and, conversely, the more alkaline a saliva, the less the calcium loss.

The observed facts seem to imply that the saliva is a much better index of acidosis of the acid ash type than is the urine. During impaired kidney action, for one cause or another, the urine is usually alkaline at the same time that the saliva is extremely acid. Under such conditions, the urine can hardly be used as a correct index of acidosis. We recommend the use of a combined saliva and urine analysis, giving due consideration to the endocrine type of the individual.

TABLE 2.—EFFECT OF TOXIN ABSORPTION ON SALIVARY REACTION

Patient R. B. S.	(Very bad pyorrhea, all teeth were removed.) Reaction before removal, saliva, p_H 6.5. 15 days after removal, saliva p_H 7.9.
Patient J. P.	(Chronic abscess with sinus, tooth removed.) Reaction before removal, saliva p_H 6.7. 28 days after removal, saliva p_H 7.9.

We are submitting a few cases (Table 1) to show the tendency for the reaction of the urine to be more alkaline in those suffering active decay.

Figure 5 is the record of an individual (W. M. W.) suffering active decay and living on an extremely high cereal diet. The diet was changed and potatoes were substituted for cereals as a form of starch. Also the amount of vegetables and fruits was increased. Over a few weeks, a marked change took place in his general state of health. He gained one pound a week throughout the period of observation. Saliva tests over this

period showed that his extremely high acidity of saliva p_H 6.1 changed in a comparatively short time (ten weeks) to an alkaline one p_H 7.1, and, at the same time, the urine, with an extreme alkalinity of p_H 8.1, was restored to a good acid reaction, p_H 5.6. At seven weeks, the p_H of the saliva was 6.2, and of the urine, 6.4.

Such tests as these show that, as far as man is concerned, a high cereal intake often has a toxic-like action on the kidneys interfering with elimination of acid salts.

Man, primarily a carnivorous animal, who has acquired the ability to use root and leafy vegetables but not the cereal grains in quantity, cannot adjust himself to a high cereal diet over too short a period of time without paying a heavy price for such a venture.

Examination of the teeth of Egyptian mummies shows the heavy toll in caries resulting from a heavy cereal diet; while pastoral people, with a heavy meat diet supplemented with milk, root and leafy vegetables, with little or no cereals, have beautiful teeth free from dental decay.

Table 2 shows the effect of toxin absorption on the kidneys and the resulting salivary reaction therefrom; there being no change in the diet covering this period.

Many such cases as the foregoing convinced us that toxin absorption interferes with acid salt elimination through the kidneys, compelling elimination through the saliva.

If we are to get a broad picture of active decay and erosin, we must see their relationship to the reactions found in pyorrhea alveolaris or periodontoclasia. Eliminating vitamin deficiency diseases and mercurial stomatitis as factors in pyorrhea, we find the reactions indicating pronounced acidosis the most common, that is, acid urine and acid saliva.

It is well known to the profession that, where active pyorrhea exists, there is a marked absence of new decay. It would seem that the reactions found in an active pyorrhea case must tend toward immunity or prevention of caries. A comparison of recorded results is given in Table 3.

TABLE 3.—COMPARATIVE STUDY OF VARIOUS CONDITIONS

Immunity to Decay
Saliva p_H strongly alkaline.
Saliva Ca moderate to low.
Urine p_H fairly acid.
Urine Ca low.
Pyorrhea Alveolaris
Saliva p_H moderate to strongly acid.
Saliva Ca excessive.
Urine p_H strongly acid.
Urine Ca low.
High Calcium Erosion
Saliva p_H moderate to strongly acid.
Saliva Ca moderately high.
Urine p_H fairly acid.
Urine Ca low to moderate.
Low Calcium Erosion—(Class V Cases)
Saliva p_H neutral to slightly alkaline.
Saliva Ca fairly low.
Urine p_H nearly neutral.
Urine Ca fairly high.
Active Decay
Saliva p_H moderate to strongly acid.
Saliva Ca low to moderate.
Urine p_H neutral to high alkalinity.
Urine Ca moderate to very high.

It can readily be seen by studying these relationships that in only one combination of reactions is body calcium conserved, that of immunity to caries. An alkaline saliva means a low calcium loss through that channel, while a fairly acid urine cuts down the loss through the kidneys.

In pyorrhea, we find an acid saliva with a high calcium loss, especially when

the urine is acid, which prevents loss through the kidneys. In such cases, the patient is usually immune to decay owing to the high calcium content of saliva, which neutralizes mouth acidity; and as a result of this high salivary calcium, suffers usually from heavy salivary deposits.

High calcium erosion is very close in its relationship to pyorrhea, and we usually find marked recession of the gums in such cases.

Low calcium erosion is very close in its relationship to active decay. There is little or no tendency for the gums to recede, and the eroded areas never take on the high polish found in the other type of erosion.

The reactions found in active decay, that is, acid saliva and low calcium, are possible only when the urine is alkaline, a heavy calcium loss resulting. The only factors found that will give an alkaline urine with an acid saliva are a high cereal diet and toxin absorption.

Figure 6 shows areas covered by immunity to caries, pyorrhea immune, high calcium erosion, low calcium erosion and active decay.

Sherman and Gettler, in their research pertaining to the acid and alkaline ash of foods, and E. V. McCollum, calling attention to the importance of calcium and the value of the so-called "protective foods," have paved the way for the dietary control of dental decay.

A previously published article covering histories of immune and carious individuals by Hawkins, Hendricks and Hills has shown that, as a class, immune individuals are large users of the alkaline forming and calcium foods, while those who suffer from dental decay have a high cereal and sweet diet and are usually low on the alkaline-forming foods, as the vegetables and fruits, also the fat-soluble vitamins.

The control of dental decay is almost entirely a dietary proposition. Eliminating those cases with marked toxin absorption, we find that a low cereal and a strong alkaline diet will slowly but surely change the acid saliva to an alkaline one. In children, a few weeks is often all that is required to make a decided change. In adults, it takes from two to three months, sometimes longer.

To secure an increased calcium content of the saliva when the saliva is alkaline, the urine, if possible, should be made acid to prevent calcium loss, and an increased amount of calcium foods rich in vitamin D should be taken.

These simple dietary rules will usually secure an alkaline saliva with a relatively high calcium, the degree of which depends on the endocrine type of the individual.

We are showing in Figure 7 a study of a group of children whose reaction placed them too close to the diagonal line for safety. An attempt was made to increase their salivary alkalinity and, if possible, the percentage of calcium.

They were given a half cup of orange juice and a small amount of cod-liver oil each day for a month, no other change being made in the diet. At the end of that period, the saliva was rechecked. The original tests are shown in crosses, the final tests in dots. The average alkalinity and percentage of calcium show a marked improvement.

Figure 8 shows the record of improvement in an erosion case when placed on a well balanced but decidedly alkalizing diet. The tests are numbered in the order in which they were taken. The time covers a period of about six months. While the progress was not uniform owing to a failure always to maintain

an ideal diet, the final result was very satisfactory. It made possible the building up of a saliva with a high neutralizing value.

While we believe that the cereal grains are responsible for dental caries and a diet totally lacking in this class of foods could not give rise to caries, no matter how acid the saliva might be, we do not advocate such a diet. In the absence of exact knowledge pertaining to a safe limit to be placed on the cereal grains, we are advocating that cereals shall not exceed 20 per cent of the total calories provided a highly alkaline and high calcium diet accompany it. Some individuals can use a very high percentage of cereals in a moderately alkalizing and calcium diet and remain immune. We find this is usually due to the superior elimination of acid salts through the kidneys or superior calcium assimilation. The great majority will have to maintain a low cereal diet unless tests show their individual ability to handle a greater percentage.

CONCLUSIONS

1. Dental decay of the enamel is caused by the removal of the intercementing substance from between the enamel rods.

2. This removal is accomplished by acids produced by the fermentation of carbohydrate foods. (Miller's theory.)

3. Probably the only carbohydrate that can accomplish this removal is the cereal grains, because it is only in this class of starches that we find gluten, or a similar product which is insoluble in the normal saliva and which, being sticky, is able to hold the fermenting starch in direct contact with the teeth.

4. This acid of fermentation will remove the intercementing substance unless it is neutralized by the saliva.

5. Neutralization is accomplished first by the presence of the alkaline salts of the saliva and secondly by the calcium content. Either or both together are able to accomplish this neutralization.

Control of dental decay is accomplished

1. By removal of the food plaques in and about the teeth through the use of raw fruits, which have a physical and chemical action on the residue; and by careful tooth brushing.

2. By maintaining a high alkalinity of the saliva, in order to neutralize mouth acidity. This can be accomplished by the use of (a) a mixed diet rich in alkaline-forming foods (fruits, vegetables, milk and true nuts); (b) removing any source of focal infection such as diseased tonsils and infected teeth, the toxins of which interfere with acid salt elimination through the kidneys, compelling the removal of acids through the saliva, and (c) maintaining a very low cereal diet, as cereal grains of probably all types, when consumed in high concentration, have a toxic-like action on the kidneys, preventing acid elimination through this channel with a resulting acidity or reduced alkalinity of the saliva.

3. By maintaining as high a calcium content of the saliva as possible with a given alkalinity, giving consideration to the endocrine type of the individual. This is accomplished by (a) a generous intake of calcium foods (milk, cheese and leafy vegetables) and either sunbaths or a diet containing vitamin D to aid the calcium assimilation, and (b) maintaining as acid a urine as possible, consistent with a generous alkalinity of the saliva. The acid urine will conserve calcium loss through the kidneys.

SCURVY: A REPORT ON THREE CASES IN ADULTS*

By ISADOR HIRSCHFELD, D.D.S., New York City

IN this brief report, I wish to present three cases of scurvy in adults. These cases, I believe, should prove of interest to the members of the Academy, as this disease, in its typical form, is but rarely met by dentists. With a more intimate knowledge, we dentists may play an important rôle in its detection when it does present itself.

Scurvy is defined by Cecil[1] as a disorder of nutrition due primarily to the lack of a specific (water soluble C) vitamin. He says: "When it occurs in infants it is called Barlow's disease. It is characterized by distinctive changes in the bones and by lesions of the blood vessels. These give rise respectively to bone tenderness and hemorrhages in various parts of the body." According to Holt,[2] the essential features of this disease are: "The extreme soreness of the legs, spongy swollen gums, swelling near the large joints, tendency to hemorrhages, and usually a history of prolonged use of fixed diet not having Vitamin C." The following selected statements from Hess's book on scurvy[3] are of interest:

> The earliest sign of scurvy is usually a change in the complexion of the individual. His color becomes sallow or muddy. He may experience fleeting pains in the joints and limbs, especially in the legs. Very soon the gums become sore, bleed readily and are found to be congested, spongy and somewhat hemorrhagic at their edges. Petechial spots appear on the body, more especially on the legs, at the site of the hair follicles, or even larger ecchymoses. If there is infection of the gums and the teeth are carious, the breath is extremely foul. Later the teeth become loose and may fall out, and the alveolar process undergoes necrosis.

In advanced cases, Hess states, "the gums swell to such an extent that they overlap and may even hide the teeth and protrude from the mouth as foul fungoid growths."

Although scurvy occurred frequently in former years among large groups of soldiers occupied in warfare and sailors on extended voyages, today it is supposed to be of comparatively infrequent occurrence, particularly in civil life. Recent literature points to the probability that it does occur, at the present time, more often than is generally recognized, especially in less typical forms. Scurvy is occasionally overlooked, mainly because some of the individual outstanding symptoms are diagnosed incorrectly and treated, accordingly, as individual entities rather than as a part of the scorbutic syndrome. The following state-

*Read before the American Academy of Periodontology, Aug. 17, 1928, at Minneapolis, Minn., as part of the annual report of the Committee on Scientific Investigation.

1. Cecil, R. L., and Kennedy, Foster (Editors): Textbook of Medicine (by American authors), Philadelphia: W. B. Saunders Co., 1927, p. 547.

2. Holt, L. E.: Diseases of Infancy and Childhood, New York and London: Appleton & Company, 1919.

3. Hess, A. F.: Scurvy, Past and Present, Philadelphia: J. B. Lippincott Company, 1920, pp. 176-179.

ment by Shattuck[4] bears careful consideration:

> It is clear that well marked scurvy in the adult may easily pass unrecognized and that failure to make the diagnosis is generally due to failure to consider the *possibility* of scurvy. If well marked cases may thus escape diagnosis, there must be a great many ill defined cases of "purpura," albuminuria, hematuria, nosebleed, indigestion, weakness, anemia, "rheumatism," visual disorders or bad teeth which could be much benefited by antiscorbutic treatment.

Considering that the gingival symptoms are at times the outstanding ones and often the first to attract the patient's attention, it is evident that the dentist who is familiar with oral symptoms of systemic disease, and who furthermore bears the foregoing facts in mind, could render valuable service to the patient by either referring him to the physician in time, or by calling the attention of an attending physician to the symptoms in the mouth, which he may have overlooked through not considering the possibility of scurvy. Indeed, this happened in two of the three cases given herewith.

Fig. 1 (Case 1).—Purplish blue discoloration of the hypertrophied papillae between the upper incisors and the upper left cuspid and first bicuspid. (The white spots in these locations are due to high lights in photograph.)

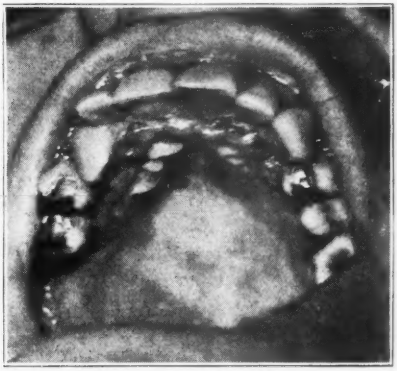

Fig. 2 (Case 1).—Purple hypertrophied alveolar gingivae on palatal side of the upper teeth. The color of this tissue is in contrast to the normal pink of the rest of the palate.

This brings me to another interesting point. There are, besides the typical cases, such as those described, certain other conditions that may be called atypical scurvy. Gerstenberger,[5] for instance, cites several such cases, and one of his conclusions reads: "The administration of the water soluble B vitamin produces in herpetic stomatitis, aphthous stomatitis, herpes labialis, acute gingivitis and ulcerative stomatitis a remarkably rapid improvement and recovery."

To go a step farther, there is a tendency on the part of some recent writers,[6]

4. Shattuck, G. C.: Scurvy with Reference Especially to Adults, J. A. M. A.; 90:1861-1864 (June 9) 1928.

5. Gerstenberger, H. J.: Etiology and Treatment of Herpetic (Aphthous and Aphtho-Ulcerative) Stomatitis and Herpes Labialis, Am. J. Dis. Child., 26:309-328 (Oct.) 1923.

6. Prinz, Hermann: Some Common Diseases of the Oral Mucous Membrane and the Tongue, Dent. Cosmos, 69:53 (Jan.) 1927.

especially European authors, to suspect that Vincent's infection is a form of avitaminosis, and accordingly to insist on the greater use of antiscorbutic diet in its treatment. In attempting to verify this opinion from a study of a large number of cases in my practice, I find that some of the very worst cases and several of the milder ones that recur frequently, have a more than sufficient vitamin intake. Furthermore, Vincent's infection usually clears up through local treatment only.

REPORT OF CASES

CASE 1.—*History.*—R. E., a woman, aged 25, single, and a school teacher, was referred to me by her dentist after failure to correct the pathologic gingival condition by local treatment. She had come to her dentist because her gums were inflamed, hypertrophied and movable, and bled on slightest provocation. His treatment included, among other things, curettage of the subgingival root surfaces and instruction in toothbrushing, which she carried out overly scrupulously. The gum turned purple, and then dark blue, in various parts of the mouth, and bled quite freely.

Examination.—The parts thus affected were mainly around all the upper teeth (Fig. 1), but were affected only mildly lingually to the lower anterior teeth. The purplish blue discoloration was confined to the gingival margins and especially to most of the interproximal papillae. Bucally to the upper left molars and on the palatal side of the upper anterior teeth (Fig. 2), the entire gingivae were swollen quite extensively and were particularly tender. Roentgenograms taken several weeks prior, showed quite a marked alveolar destruction in these areas. The very tips of some of the papillae were slightly necrotic and fetid breath was noted. Most of the teeth were more or less mobile. The patient had noticed that the bluish, swollen condition of the gums would become

Fig. 3 (Case 1).—Photograph taken about one month after antoscorbutic treatment was instituted. The deep purple discoloration had entirely disappeared and the swelling of the gum was considerably reduced, but an entirely new pathologic picture was now presented; namely, a marginal gingivitis. (The dark markings of the margin indicate bright red areas. They are located at points other than those which had the scorbutic discoloration.) This condition resulted from lack of function and hygiene. Because of colitis, the patient's diet was restricted to refined food not requiring mastication. Through fear that traumatization might bring back the former gingival symptoms, she did not use a brush, with the result shown above.

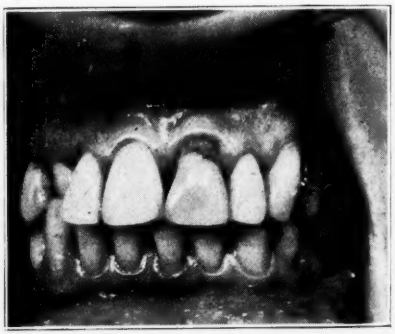

Fig. 4 (Case 1).—Photograph taken about three weeks after the patient resumed proper toothbrushing. The gums returned almost to normal, although no special treatment had been given since the photograph in Figure 3 was taken.

apparent in different parts of the mouth immediately after local injury.

A smear from the diseased area brought the following report: There are many pus cells, practically all well preserved, a few red blood cells, no large flat epithelial cells, a moderate amount of mucus and a small number of bacteria, consisting chiefly of spirilla, with a small number of fusiform bacilli and a scant sprinkling of diplococci.

The patient appeared cachectic and much underweight. Questioning brought out the fact that, coincident with a markedly lowered vitality two months previously, the gums began to cause annoyance. She also complained then of pains about the ribs, across the feet and at the calves. Any physical strain was painful. The physician prescribed high shoes, but they gave no relief.

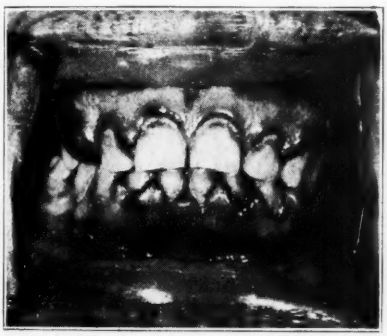

Fig. 5 (Case 2).—Swollen gums over upper right cuspid root, extending to the opposite teeth; necrotic tip of the papilla between the upper right central and lateral incisors. Hypertrophy of the rest of the gums, both marginal and interproximal, can be seen, as well as easily produced marginal hemorrhage on the lower left side.

Diagnosis and Treatment.—These facts suggested to me a diagnosis of scurvy, which was further corroborated by the information that her diet had been highly restricted for a long period of time owing to a chronic ulcerative colitis.

On consultation with her physician, who concurred in the diagnosis, orange and tomato juices were added to her diet. Within four days, the gingival swellings receded to less than one third, and the patient could eat and talk comfortably for the first time in weeks. The high shoes were discarded, and the patient improved generally. However, as this diet seemed to aggravate the intestinal condition, which was at its best prior to the antiscorbutic treatment, it was discontinued at the end of a week and other foods containing vitamin C, but less aggravating to the colitis, were substituted, with very satisfactory results. As the swollen gingiva became thinner, the discoloration gradually faded back to the normal pink, except on the palatal side of the upper teeth, where previously existing pyorrheal pockets retained the slightly bluish tint characteristic of pyorrhea.

Case 2.—*History.*—L. S., aged 32, a housewife, was referred by the mental hygiene

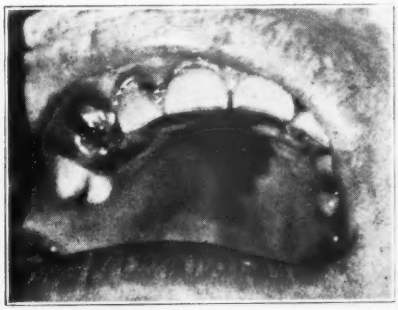

Fig. 6 (Case 2).—Shiny appearance of the swollen gingiva covering the broken down root of the upper right cuspid. The different color values described in the text are evident.

department to the dental clinic at the Beth Israel Hospital for treatment of painful and bleeding gums. She first became aware of the diseased condition when a blue swelling, around and over the edges of the root of the broken down lower left first bicuspid, opened and discharged a dark exudate, after which a necrotic patch developed. About a week later, a similar, large swelling grew up over the sharp edges of the broken down upper right cuspid. The photographs accompanying this case show how both of these swellings extend up to the occlusal plane of the opposite teeth. (Figs. 5-6.) They were quite hard, smooth and round, resembling part of a plum. The slightest pressure caused pain

and brought hemorrhage from the part cut into by the root. Soreness was soon felt in other parts of the mouth.

Oral Examination.—At the first visit, the following additional notations were made: The hypertrophied papilla between the upper right central and lateral incisors was purple and separated from its gray but hard necrotic point by a blue line of demarcation. All the marginal gingivae from this point around to the left posterior part of the arch were more or less puffed and shiny, and were an old rose. The lower gingivae (Fig. 7) were also hypertrophied, varying from old rose to purple and dark blue or almost black. These darker parts bled very easily at the edges. In addition, ecchymotic patches on the forearms, with a history of faulty diet, suggested scurvy.

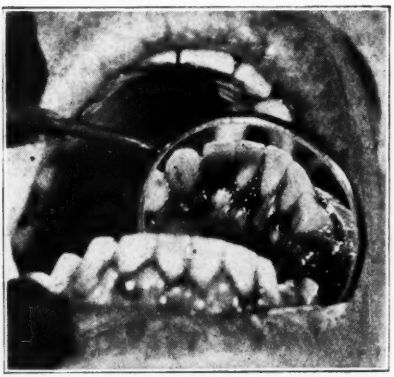

Fig. 7 (Case 2).—Lingual view of the lower anterior part of the mouth. The blue discoloration in the papilla between the central incisors does not include the actual tip. This exclusion of the tip from the discoloration, which may also be noted between the upper central incisors in Case 1 (Fig. 1), seems to be characteristic in scorbutic mouths. Distally to the lower left cuspid may also be seen part of the swelling described in text.

(Four months previously, the patient had consulted a gastro-enterologist, who put her on a test diet of cereal for four days. Being of very low mentality, she had not returned for the test, but continued to eat cereals [farina, barley, white bread] exclusively for four months, up to the time of her visit to the clinic.) She was instructed to eat vegetables and fresh fruits, especially oranges. Two days later, she returned with a worse condition in the mouth. She had not yet changed the diet; nor had she done so up to the time of the next visit. It was very interesting to note that, in this period of four days, the parts, which at the first visit were rose colored, had changed to purple, and those which were purple were now a bluish black.

Course.—The patient was taken to the hospital ward, where she was persuaded to eat the prescribed food. Within several days, the case was cleared up.

A smear taken at the first visit disclosed many pus cells and numerous Vincent organisms (spirochetes predominating), diplococci and staphylococci.

Fig. 8 (Case 3).—Labial view described in text.

Hospital Record.—In addition to the facts already brought out, the hospital record furnished the following: The family history was irrelevant. The patient's habits were not abnormal. There was dyspnea on exertion, with no cough, but sputum (colorless) present. The appetite varied and the bowel action was irregular. There were frequent headaches and nocturia (two times). The patient showed muscular weakness and thought that she had lost some weight. She had undergone an operation for abscess of the breast six years previously. The menses began at the age of 16, occurring every four

weeks and lasting two days. The past three months, the interval had been only three weeks, the period lasting from six to nine days, with menorrhagia. The patient had had three children. There were no miscarriages.

A complete physical examination showed that the teeth were in poor condition. The gums were swollen, spongy, very red and tender, and bled easily. The tongue was clean. The tonsils were buried. The pharynx was congested. There was tenderness over the ribs anteriorly. A punctate rash was noted over the legs and arms. There was an area of induration over the middle third of the right tibia and areas of ecchymosis over the right thigh and both forearms.

The temperature fluctuated around 99 F.; the pulse, between 72 and 90 (average 82).

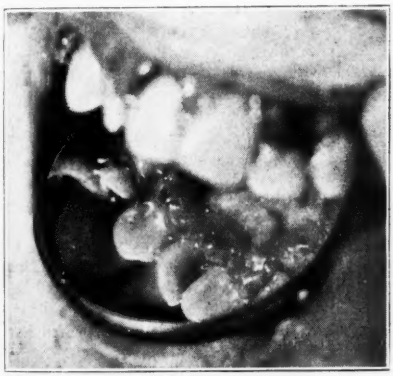

Fig. 9 (Case 3).—Hypertrophy of palatal gingivae.

The respiration rate was 24; the blood pressure, systolic, 100; diastolic, 60.

The laboratory tests showed albumin in the urine. The blood examination showed red blood cells, 4,600,000; hemoglobin, 65 to 70 per cent; white blood cells, 6,200; platelets, 210,000; coagulation time, four minutes; bleeding time, three minutes; fragility: hemolysis beginning at 0.5 and ending at 0.4. A smear from the gums showed staphylococci and small chains of streptococci. A roentgenogram of both legs and lower jaws revealed no bony lesions.

A diet containing three oranges (four times daily), tomatoes and green vegetables was prescribed. Sedatives were given to aid in control of the pain, which interfered with sleep (amidopyrin, U. S. P., 5 grains; sodium bromid, 20 grains). The patient was dismissed with the condition of the gums relieved and the general condition improved. She was referred back to her dentist and a diet advised.

Case 3.—A. C., a woman, aged 22, single, who had been a worker in a glass factory, was observed by me six days after her admission to the Greenpoint Hospital, Brooklyn, N. Y., in consultation with Bertram B. Machat, chief of the dental department.

Oral Examination and Diagnosis.—There was a generalized hypertrophy of the gingivae both labially and lingually of the lower anterior teeth, and on the palatal side of the upper anterior teeth. Contrasted with this

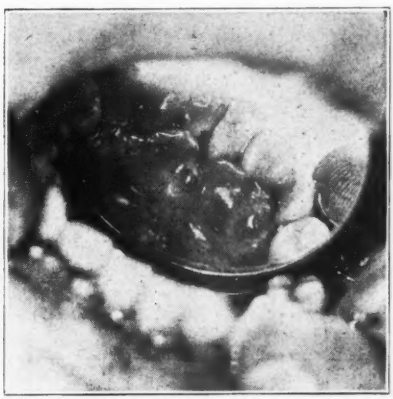

Fig. 10 (Case 3).—Marked hypertrophy of lower lingual gums.

in form were the more or less isolated, swollen interproximal papillae, which extended down over the labial side of the upper teeth. The swollen gums were, at this time, mostly purple and in some parts deep blue. This denoted some improvement, as the blue had predominated at the time of admission, according to the dental intern. All parts bled easily and were very sore. Some of the posterior teeth were broken down and others missing. The mobility of the remaining teeth was comparatively slight.

The clinical condition of the mouth pointed very strongly to scurvy and the facts in the

hospital chart corroborated this diagnosis. For the past five months, she had subsisted exclusively on pasteurized milk. The patient was intractable, and though only slightly improved, left the hospital that afternoon against the physician's orders.

Hospital Record.—The following facts were obtained from the hospital record: The patient, who left elementary school at 15 years of age and had been a clerk in a glass factory, handling material, for two years, was admitted, Sept. 17, 1927, with a diagnosis of blood dyscrasia, a provisional diagnosis of aplastic anemia and a working diagnosis of scurvy, leukemia and epulis. The final diagnosis was scurvy. The chief complaints were nosebleed, of four months' duration; headache, one year; anorexia, four months; photophobia, one year, and bleeding of the gums, two months. The patient had had influenza three years previously. She frequently had sore throat, with a rise in temperature and headache. She had been in the Neurological Institute for three weeks in 1926 for "nervous indigestion." She had spells of crying and headache and had been nervous for the past three years. The right leg had been swollen since childhood. The appetite was good.

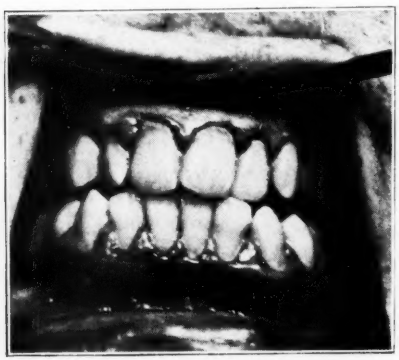

Fig. 11 (Case 3).—Photograph taken ten months after treatment for scurvy. Although no local treatment whatsoever was given in this case, the reduction of hypertrophy is very marked.

The menses started at the age of 14, lasting three days, every thirty days. The periods had been regular up to six weeks previously, when there was a metrorrhagia continuing to the present time. There was no pain and no discharge.

The present weight was 70 pounds. The patient had weighed 132 pounds three years previously, and 110 pounds the previous winter. She had been in poor health for the past three years, with loss of appetite. In May, 1927, she had nose bleed, not controlled readily, bleeding somewhat for a month. At that time, the gums became very tender. About two months previously, the gums appeared swollen and red and a slight amount of blood oozed from them. August 10, the gums bled quite profusely, but there had been no bleeding since. A headache continuing for the past year in the right temporal region was not relieved by medication. The loss of appetite extended over five months. The patient drank three glasses of milk a day. There had been photophobia for the past year, without any loss of vision.

The patient was constipated. There was no blood in the stools. Local pain on defecation had been felt for the past week but no abdominal pain. There was eructation. Coughing and sweating were absent. While the temperature was usually above normal, the patient complained of feeling chilly. There was no precordial pain. The heart beat forcibly and occasionally the patient had seen bluish spots on the skin. She was short of breath. There was muscular soreness all over the body, with headache. The condition suggested blood dyscrasia and pernicious anemia.

On examination, the patient appeared markedly ill. She was emaciated and exceedingly pallid. The conjunctiva was markedly injected, but no petechiae were seen. The pupils were equal and regular and reacted to light. There was no loss of extra-ocular movement. The tongue protruded in the midline, presented a glossy appearance, but was not smooth, and was quite tremulous. The teeth were in poor condition. The gums of both the upper and the lower jaw were markedly swollen, red, engorged, spongy and tender, and projected down over the free portion of the teeth. The thyroid was not felt. Several small glands were palpable but not tender. There was marked visible pulsation of the carotid vessels. The ribs and sternum were very prominent. The abdomen was scaphoid. There were no petechiae nor areas of ecchy-

mosis. The abdomen was soft but no masses were felt. The Murphy sign was negative. There was a slight amount of edema of the angles, but no bone tenderness, no loss of motion and no signs of hemorrhage. The lower abdominal reflexes were present. All reflexes, including the knee jerks, were exaggerated. The conditions suggested pernicious and aplastic anemia.

From the findings and history of moderate menorrhagia and epistaxis, the physician's tentative diagnosis was scurvy, leukemia and multiple epulis (with sarcoma).

The patient suffered from a secondary psychoneurosis from her long illness. She was advised to get as much sunshine and fresh air as possible.

The blood examination showed: white cells, 6,000; red cells, 2,300,000 (anemia); some anisocytosis; hemoglobin, 75 per cent; differential count (normal): polymorphonuclears, 68 per cent; small mononuclears, 25 per cent; large mononuclears, 6 per cent; other cells (young leukocytes), 1 per cent.

The physician ordered a urinalysis (catheterized specimen); light diet; a mouth wash (Dobell's solution); forced fluids ("Imperial granum," 6 ounces every four hours); phenobarbital, U. S. P., one-half grain, and triple bromid, 15 grains.

The patient permitted me to take photographs of her mouth at her home two days after she left the hospital. After getting home, she drank more orange juice, and further improvement in the gums was now evident. The blue had almost disappeared; the prevailing color was purple and a few old rose areas. The swelling was somewhat reduced. (Figs. 8-10.)

Ten months later, I saw her again. She had been under the close observation of a physician, and had improved greatly. Her weight had increased from 70 to 117 pounds. Although her diet is quite satisfactory, she is still slightly scorbutic, as is evidenced by a tendency of some of the systemic symptoms to recur frequently. In spite of the fact that she had had no dental attention during that time, and has a fair amount of cervical deposits, the mouth (Fig. 11) appears almost normal except for a few slightly hypertrophied papillae on the labial side which, in spots, are still an old rose.

COMMENT AND SUMMARY

1. Current medical literature indicates that it is not uncommon for physicians, when prescribing a strictly limited diet, to eliminate, unwittingly, the antiscorbutic vitamin.

2. Local traumatization, such as instrumentation or hard brushing, may bring out or aggravate existing gingival symptoms of scurvy.

3. A diagnosis of scurvy was made in two instances from the oral symptoms, with the systemic symptoms used for corroboration. This points to the importance of equipping the dentist with a knowledge of oral symptoms of systemic disease so that he can render additional valuable aid in health service.

4. From my observations in this very limited number of cases, it seems to me that there is a tendency to a definite sequence in color changes during the progress of the disease. The normal pink gives way to old rose, which in turn changes to purple and then to dark blue and almost black, while, during recovery, the change is in the reverse order.

5. Since an old rose color seems to be one of the earliest gingival symptoms of scurvy, investigation from that angle may prove to be a constructive step in an early diagnosis.

730 Fifth Avenue.

THE USE OF MINERAL OXIDS AND OTHER MEANS FOR PRODUCING NATURAL TOOTH EFFECTS*

By E. L. PILKINGTON, D.D.S., Detroit, Mich.

IN the preparation of this paper on the various methods for reproducing natural tooth effects in dental ceramics, it has been very interesting to search the dental literature for papers others have written on this subject. I have found, during this search, that very few articles have been written on staining. In fact, I have found little to indicate much interest in this subject.

There has been much time devoted to the study of jacket crown and inlay work; much has been written on the various methods for securing definite results both as to form and fit, and there has been a great deal of literature on cavity and root preparation. But a perusal of the books and papers on porcelain work will convince one that there has been comparatively little thought given to the staining problem. The best book on porcelain today devotes only a few paragraphs to this subject.

OLD STAINS

Until recently, there have been few stains on the market, and the few which were on the market were hopelessly inadequate. These old stains discolored in the mouth and were soluble in the oral fluids. They were easily worn off, or polished off, and did not stand up for any length of time in even the most favorable places.

MODERN STAINS

The stains now on the market are of a better quality, and might be termed colored glazes or colored porcelains, as they have many characteristics in common with glazes and porcelains. However, even these stains as marketed do not embody all the requisites of perfect stains. I find it necessary to have additional stains compounded to supplement them, especially for use in surface staining.

These modern stains are very brittle when fired in any bulk and sometimes bubble. The colors are too bold and brilliant, and do not produce the subdued or blended effects that are so characteristic of teeth. All of these faults are brought out in inserting stain in the incisal tips of incisors. The insert will chip easily when ground, is apt to be full of bubbles and will obviously have more pigment than is natural. Better results can be obtained by mixing a small quantity of stain with a light colored porcelain. This will tone down the color and will give the insert the necessary strength and toughness.

The question naturally arises, "Why not use the darker shades of porcelain for coloring these tips?" The reason is that porcelain is translucent and does not retain its natural color when inserted in an incisal tip, or laid on the surface of a

*Read before the Section on Partial Dentures, Crowns and Bridgework at the Midwinter Clinic of the Chicago Dental Society, Jan. 15, 1929.

crown. It will be found necessary to add stain to maintain the desired shade and prevent the color from losing its true shade value owing to transmission and refraction of light through the translucent tip. The addition of an opaque stain practically stops the light rays and allows the insert to keep its real color.

Another disadvantage which occurs in jacket crown work in using really high fusing stains is the danger of pitting or blistering the surface of the crown. As a rule, the worker completes the jacket crown before he attempts to stain it; which necessitates laying the high fusing stain over an already glazed surface.

After the tooth is fired, cooled and handled, it will be found that there are many small black specks that were not on its surface after the first glazing. The supposition naturally follows, that there were small bubbles invisible to the naked eye just under the surface of the original glaze. These are opened during the second firing, and, when the crown is handled, foreign material is introduced and a black specked tooth results. Boiling in soap suds, acids or alkalis has little effect on them, and the crown is ruined.

This can be avoided by laying on the stain before the final firing, and glazing both stain and porcelain at one operation. Subsequently, if it is necessary to use more stain, one that matures below 2,000 F. should be used. The lower temperatures do not open the bubbles.

OVERGLAZE OR SURFACE STAINING

The modern stain is composed of a small percentage of metallic oxid mixed with a glaze which must be suitable for use in the mouth. This mixture is placed in the furnace and fired, after which it is cooled and ground to exceeding fineness. This will give it, when mixed with glycerin, a consistency which makes it possible to use it in much the same way that an artist uses paints and water colors.

These stains can then be painted on the surface of the tooth to represent any colored stain from light blue or green to dark brown or black. The only limit to the effects procurable with this type of staining is the experience and ability of the ceramist himself as an artist.

The fact that the oxids are mixed with a glaze which has the ability to vitrify on the surface of the tooth makes it possible to use these stains as surface stains with the assurance that they will not change. This quality makes them a true surface or overglaze stain.

UNDERGLAZE AND SUBSURFACE STAINING

The porcelain worker finds that, although the overglaze stains give beautiful results and are indicated in many cases, there are teeth in which these stains or colored areas are distinctly underneath the surface. This is a condition commonly met with in bridgework as well as jacket crown work. Here, it is necessary to stain the replacement tooth or facing in order to reproduce some peculiarity in the adjacent teeth. In some cases, there are longitudinal checks in the enamel which are stained; in others, subsurface yellow or brown spots, and, again, white decalcified looking spots which are in the body of the enamel. I have even seen cases in which it seemed advantageous to simulate synthetic fillings with stained borders or porcelain inlays, and, in other cases, any part or all of the foregoing types of staining.

It is a relatively simple matter to obtain any of the foregoing effects. I shall take them up as classes or types of staining, rather than singly.

BROWN, YELLOW OR WHITE SPOTS

The first thing to be done in duplicating these colored areas under the surface of the tooth is to make a chart of the stains and markings on the adjacent teeth and also a drawing of what we wish to reproduce in our facing.

Next, the labial surface of the properly selected facing is ground off to about one half its original thickness; care being taken to run slightly over the mesial and distal margins so that there will be no joint showing in the finished product. This labial grinding must, of course, be done to suit the case in hand. It is not always necessary to grind to the foregoing extent. A few trials will prove sufficient for a perfect understanding as to how much is to be taken off.

The proper stain is then chosen, according to the color guide, is mixed with glycerin, and is applied to the facing with a small brush or sharp pointed instrument. This is drawn or painted on exactly as we wish the finished stain to be, and is placed in the furnace and fired. This fixes the stain in exactly the position desired.

Now, porcelain having the proper enamel shade is chosen, of approximately the same fusing point as the stain, and, of course, of a lower fusing point than the porcelain in the facing. The nearly transparent porcelain is carefully applied to the facing and the necessary convexity is built up. The piece is then fired to a high biscuit finish. After this is done, the labial surface is ground and fired until it is glazed to match the adjacent teeth in texture.

It will be found that the shade of the tooth as a whole is unchanged, because the original colors of the facing show through the translucent porcelain. The stains will be found to be very natural in appearance and have that blended subsurface quality so characteristic of this type of stain.

LONGITUDINAL ENAMEL CHECKS

If a longitudinal enamel check seems desirable in the same tooth, the stain used for this check should be of a lower fusing point in order that the previous work may not be overfused. To make this check, the proper color of stain is mixed in glycerin, and a draftsman's drawing pen or a very sharp pointed lancet is dipped in the stain and the check line is drawn on the labial surface according to the chart and fire.

SUBSURFACE STAINING

The placing of a colored stain to represent a decalcified area or a brown spot under a thickness of porcelain might well be termed subsurface staining, because of its deep position. I find that it is quite necessary to place it at this depth to obtain the most natural effects. An even more natural effect can be secured by placing the stain on the tooth; following immediately with the porcelain, and firing the two together. This gives, instead of a flat area, a better blended color that is obviously at different depths in the tooth and thus enhances its naturalness.

The effects obtainable in underglaze or subsurface staining are much softer, more harmonious and pleasing to the color sense, than overglaze staining. This is due to the porcelain or glazes melting slightly with the colors; which, by destroying the hard edges of the stain, gives a soft effect.

The alteration which the colors undergo in firing is very marked. This makes successful staining of the tooth difficult to master; for, with the majority of stains, the ceramist works in the dark and produces effects which bear little re-

semblance to the appearance his work will have when fired. For instance, a brilliant red may become a drab gray after firing, or a brilliant green may become a brown, etc. One way to overcome this troublesome condition is to take these stains as they come from the manufacturer and divide each bottle into three or four parts. For example, some low fusing stains come in six shades. By dividing each into four parts, we have twenty-four portions. These can be mixed in various proportions, so that we have a number of stains that will have a definite shade. After we have mixed and bottled the various proportions, we can fuse a sample of each on a facing. This facing can be waxed on the cork of its bottle, or on a record card, where it is always available for use. By this method, we can be absolutely sure of the shade at all times, and, incidently, save ourselves much disappointment. This can be done with any other stain on the market, and, in fact, should be done, since we rarely find a tooth that calls for a stain as it comes from the manufacturer.

STAINED PORCELAIN INSERTS IN INCISORS

A large number of colors is a great aid in the reproduction of stained dentin in the worn incisal tips of anterior teeth.

By having the exact shade, a lot of experimenting with colors and wasted time is eliminated, and, incidentally, the work is much more enjoyable. The technic for these insertions is comparatively simple and can be carried out in a few minutes without any special training.

First, the insert is cut with a small knife-edged stone to 1 mm. in depth, the shape being copied from the adjacent teeth. A diamond drill can be used to advantage in the corners.

Next, the proper color is selected, low fusing stain being used, and a small quantity is mixed with low fusing porcelain in water. This is inserted in the tip and triturated thoroughly, care being taken to have a slight excess to compensate for shrinkage. It is then fired.

Finally, it is polished with fine green stones, coarse sand disks, fine sand disks and then tin-oxid and a felt cone.

The resulting insert will have the dense texture of perfectly fused porcelain and will have a beautiful polish, which is necessary to bring out the best tone in the color, thus adding to the natural effect.

There is one precaution which I have left to the last for added emphasis, and that is, we must mix a minimum of stain with a maximum of porcelain and still get the right shade. This and this alone will insure the constant results in regards to both the texture and the color that is desired.

STAINING THE INCISAL THIRD

In conjunction with the stained incisal insert, we frequently find incisors which have a dull opaque color, usually a gray, in the incisal third of the tooth. It seems impossible to get a facing or a jacket crown composed of ordinary porcelain to match this queer shade, owing to the translucency of the porcelain. Even the darkest of these shades, as they come from the manufacturer, will transmit so much light that the color values are lost, which makes them worthless in these cases. I have found that the only way to overcome this difficulty is to grind off the necessary amount from the incisal third, select the proper shade of stain and, again using a minimum of stain with a maximum of porcelain, build on this incisal third, and fire. This type of staining is neither subsurface nor over-

glaze staining. It is really the substitution of a true stained porcelain for a portion of the labial surface of the parent tooth. You will find this a simple procedure and very useful in this type of case.

TRANSPARENT TIPS

Another problem that we meet frequently in jacket crown work is a reproduction of that almost crystal clear enamel in patients below middle age. Underneath this enamel, the dentin appears to be scalloped or waved, showing three well-defined lobes.

These might well be termed dentinal mamelons, as they seem to follow the shape of the three little enamel eminences, or tubercles, called mamelons, which are on the cutting edge of the tooth when it first appears through the gums. Later on, when the mamelons are removed by wear, the three lobes in the dentin remain. These usually are a pale yellow, but the color may be so rich that it is even necessary to employ stain to get the exact tint.

The technic for securing this type of restoration is as follows: The jacket crown is constructed to full size and contour, only the body color being used. For example, if the cervical color is No. 5 high fusing porcelain, the entire crown is constructed of No. 5. This is brought to nearly a high biscuit finish in the furnace, and checked for size and shape in the mouth.

Now, a chart is made of the exact amount of enamel on the adjacent teeth and any peculiarities the three lobes may have. Also, we note exactly how far towards the cervix the translucent enamel extends.

After this is done, the tooth is ground to the exact extent shown on the chart, and checked in the mouth. As a rule, it is not necessary to grind much more than half way toward the cervix. The three lobes are then cut out with a green knife-edged stone. If it is necessary to stain them, now is the time to do it, using a high fusing stain, with the overglaze technic already described.

After the tooth is ground and possibly stained, we take the transparent enamel body and build the tooth up to size and form, fire it to a high biscuit finish, and grind to shape, using green stones. This can then be checked in the mouth, and finally placed in the furnace and glazed.

A result will be produced that cannot be excelled, one which will be highly satisfactory both to the patient and the dentist. This technic also lends itself to either subsurface staining or overglaze staining. In fact, some beautiful effects can be created by a combination of these methods where indicated.

AGED TEETH IN DENTURE WORK

The prosthodontist is the one above all who can utilize to the fullest extent the art of staining to reproduce aged or worn effects in restorations. There is no place in the ceramic field where art can be better applied than in the construction of natural looking dentures. There is no obstacle too great for these elderly people to surmount in their quest for the fountain of youth, and the appreciation and regard they have for the man who fits himself in this field is very gratifying.

The insertion of a tooth in the mouth of a patient of 50 which is so perfect that it could only be found in a person of 18 is so at variance with nature that even the laity recognize this absurdity and have been condemning it for years.

There should be teeth available for this work. There should be stained and aged teeth to represent thirty years of wear, and for every five-year period up to fifty. These could be progressively

stained and aged so that the very best in naturalness could be had. The tooth manufacturing companies contend that, as yet, there is no demand for this kind of a product, but this contention is not supported by a large number of specialists and general practitioners throughout the country.

At present, the only way to arrive at the solution of this problem is through the field of staining. Any one or a combination of the above mentioned types of staining can be used here to advantage. There are stains, such as the various low fusing stains, which mature at temperatures so low that the gold pins in the plate teeth are rarely affected. There are also higher fusing stains which glaze at a temperature high enough to ruin these pins. With these higher fusing stains, it is necessary to stain the teeth without pins; and hence, it is necessary to remove them. This is easily done by placing the teeth in the furnace and drawing the pins when the solder flows. This can be avoided by ordering teeth with unattached pins and soldering them in after the staining is complete.

Again, there are platinum pin teeth and finally pinless teeth, which have no pins at all. So that we have an assortment which is sufficient for any case.

THE IMPORTANCE OF TOOTH FORM

A paper on the subject of staining teeth would not be complete without stressing the importance of tooth form as an aid to realistic results in dental ceramics. The importance of proper anatomic form cannot be emphasized enough. This is especially true in jacket crown work when the crown is built from the raw materials. It is here that ability to carve and mold the plastic mass into a perfect replica of its counterpart is very valuable. We find that, without a perfectly carved tooth, it is difficult indeed to stain with any degree of success. It seems that, with the first essential lacking, the natural effect cannot be secured, no matter how skilfully the stain is applied.

A better result can be obtained with a perfectly carved tooth with well-blended porcelain than can possibly be obtained with the best staining on a poorly carved tooth. So it is obvious that one of the first essentials in this work is the development of sufficient skill to perfectly reproduce those characteristics in teeth, which are so necessary for natural effects.

CONCLUSION

I wish to emphasize the fact that, for ordinary staining, there is no special training needed; nor is it necessary to have much expensive equipment to obtain good results.

Most of the staining that I have mentioned in this paper can be done in one of the small glazing furnaces that are on the market and with a set of porcelain stains. These, with a jar or two of porcelain and a little experience, will be all that is necessary to give beautiful and gratifying results.

6-263 General Motors Building.

DISCUSSION

By *Adolph E. Schneider, Chicago, Ill.:* I wish to commend Dr. Pilkington on his courage in writing a paper on this subject. After working with porcelain since 1900 and with the various phases of a new technic since 1908, I have found it so hard to cast the subject in a definite technical form that I have, up to this time, deemed my knowledge of demonstrating my information in lecture form inadequate. I cannot recall, in all the cases I have handled, any two cases that were alike. A definite classification of the work, although there is much that is similar, or the artistic clarification of color as a helping problem for the dentists is worthy of a book in itself. As to coloring teeth so that they blend exactly with their surroundings is not so difficult that most of our better operators cannot do it

quite satisfactorily. I know from Dr. Pilkington's work that I have seen that he is very adept. I believe that he is wrong when he says the profession lacks interest in the subject. Certainly, this is not true of the better operators, who show the progress made by the profession as a whole. Lack of contact with the actual work of these men is responsible for Dr. Pilkington's attitude, I believe. The average dentist is no criterion. There is no incentive for him to be much concerned with colors. He can do a fairly good piece of work by paying attention to tooth contours and position, and as there are so many variations in color in most mouths, he can usually satisfy the average patient. Consequently, we must go back to the men who find it profitable to make an extraordinary effort and who have enough pride in their accomplishments to turn out truly artistic cases. Of these men, there are few with the ability to express themselves well enough to take the stand and explain the intricacies of this work to the profession at large. Dr. Pilkington says that the old stains were inadequate and would not last, and consequently, we had no permanent way of duplicating defects; and that the present stains are much better. I have never met the color requirements of a mouth since 1908 that I have not been able to duplicate with the materials and methods then in vogue. I had a case in my office just a few days ago with a multiplicity of colors and stains and they were still good after ten years of hard usage. I will even say that, as far as our porcelain work and its various applications are concerned, there has been no new technic evolved since that period (1908-1912). There have been a number of men who have taken the technic evolved at that time and have varied it enough to make it appear that they had something new, but the technic of that time is still the better and more simple one to use, rather than the complicated methods involved in the later innovations. Returning to the old stains: I do not know how far back Dr. Pilkington wishes to go to find good, servicable mineral stains. We had the high fusing mineral stains back in 1908, and from the S. S. White Company, I learn that they brought out their high fusing stains in 1903, with Edward A. Royce's improved shades in 1911; which does not make them too old for all of the porcelain workers of the present to have used them since they took up porcelain work. The dividing line between the old and the new methods takes us back to the period of 1908 when porcelain work was at such a low ebb, so low in fact that there were few operators using it except for inlays here and there. It was from this time on that a renewed interest was aroused because of the new technic evolved for handling all porcelains, with a simplified technic for laying colors. Many men again took up the work and with great satisfaction, too, if I am any judge from the effects of my twelve years of demonstrating from coast to coast and from the many operators who came to my office to get my ideas. Among the old porcelain operators with whom I came in contact, men who did some of the most beautiful work in natural restorations that it has ever been my privilege to see, were J. H. Prothero, of Chicago, and Louis Dayan, now living in Burbank, Calif., who worked with another of our better pioneer workers in porcelain, William H. Taggart. The latter turned out some continuous gum dentures the like of which I have never seen since, although they were made by the old methods. Written records of artistry in dentistry are few, but we have had some fine operators who inspired us and who deserve a world of credit. As to the manufacturers: what paying incentive have they had, from a concerted action by the profession, to produce porcelains or color stains that would duplicate exactly the most desirable shades that we need? Unless it can be made to pay, they will not go to the expense necessary to produce these materials. I tried years ago to form a porcelain society of operators within our national organization so that we could make a demand for the right materials for all of our porcelain work, but the men were not sufficiently interested, for various reasons. Efficiency is not in the excellency of the tools used, but in the vision and the coordination of mind and muscle of the operator and designer. In other words, by persistent hard work, all things become easy, and I feel that it is up to some of our younger operators to build up mind pictures of what they would like to attain and then work hard to fulfil that dream. Therein lies our only hope of progress in our chosen profession. There are too many intellectual parasites in the profession who are only too glad to let others do the devising and the working and then they introduce the work of others to the profession as their own. There are a few matters along this line that I hope to clear up in the near

future in a story of porcelain as I have seen it these last twenty years or more. I believe in placing credit where credit is due, and while on this line of thought, may I congratulate Dr. Pilkington on the work that he is doing with color impositions for the profession, and may I evidence the hope that he will shortly give us a fundamental scheme, a classification of color laying that would be of great help to the novice as well as to the dental porcelain operators at large.

W. D. Vehe, Minneapolis, Minn.: Esthetics, the study of the beautiful, has its roots deeply imbedded in the fabric of restorative dentistry. In fact, it lies deeper than this, since an evaluation of the human mouth begins before any restorative processes are undertaken. The term "esthetic" must of necessity be relative, in that all are not agreed when a thing is beautiful, and one's conception of this subtle quality changes as his development progresses. For the sake of this discussion, it is reasonable to assume that the profession is agreed that a restoration is beautiful when it conceals itself in the mouth, i. e., when it is in complete harmony with its surroundings. Now, in examining such a structure to determine what the essentials might be that produce such a result, it will be found that there are a number of factors which are easily recognizable. First, it will be apparent that the foundation must be healthy and that the replacement must promote this condition, and, secondly, it must accurately simulate the color, form and position of the adjoining teeth, if any are present, or of what these were if they are now absent. Dr. Pilkington chose to express himself in one phase of this important subject, i. e., that of the coloration or staining of our porcelain substitutes. Much can be done toward helping to produce a more natural and pleasing effect in our porcelain restorations of whatever nature by the intelligent and judicious use of these stains. Perhaps one can obtain a greater familiarity with this problem if he thinks of these stains as highly colored porcelains, which they really are. There are colors used, of course, that are not mixed with a fusible material, but these are not used for staining purposes except to be mixed with our porcelains to alter the colors. This is the way in which porcelains are colored in the first place, but these materials are not used much in our laboratories. With such a conception of our situation, any problem of color in porcelain or on porcelain is a matter of selecting a correct color of stain first of all and then applying it in an intensity over an area to best meet the immediate requirement of esthetics. It is my experience that best results in coloring or staining our porcelain restorations are obtained by first observing the true color and its intensity in the natural teeth and then determining just where it is placed in or on the teeth. It seems to be important to place our color as Nature has it placed, and if this color is found to be on the surface, we are wise to place it in our work in the same way. On the other hand, if the coloration is observed to be on the interior, whether in the enamel or the dentin, our colors should be placed precisely in the same location. I rarely disregard this principle. I may do so when I attempt surface staining to alter the color of a porcelain piece that is found to be too light. Pleasing results may be obtained in this way, but it is not often that I resort to this method of changing a color. There is another way of looking at stains. We should keep in mind that it is as simple to intensify porcelain colors with stains as it is to subdue staining colors with porcelain. It all depends on what the needs of a case may be. When porcelain is found to be insufficiently colored, stains may be used to strengthen it, or any colors of whatever nature may be incorporated in the porcelain, provided they will stand up under the fusing temperature of the porcelain. In diluting the intensity of a stain with a porcelain, one must be careful to take the color of the porcelain into consideration so that the diluted stain color and that of the porcelain do not form a third color that is not desired. For some types of staining, our colors of even today are not ground sufficiently fine. It is only in the lower fusing stains that this fineness can be obtained. The beginner's tendency is to use too much color, and what looks right to him in the laboratory when he is applying it to his work quite generally proves to be grossly overdone when it is placed in the mouth. When I place stains on the interior of my work and do not mix these stains with my porcelain, I find that I like my result better when I have covered this area stained with porcelain that accurately simulates the enamel color. I also find that overfusing a stain is ruinous to certain colors of it, while not so much to other colors of the same stain. That, of course, is logical when one considers the chemistry of stains.

Dr. Pilkington outlines his technic for staining checks in porcelain teeth by placing them on the surface by the aid of a draftsman's pen or a fine point, and that leads me to state that I have not been able to reproduce these lines in this manner. I find that usually I cannot make my line narrow enough, and so I resort to scratching a line into the surface of my work with an instrument on the order of a diamond graver, just where I want this line to be. This enables me to confine the color to this groove, and it seems to look more natural also in that it is placed more nearly where it is placed in the surface of the natural tooth. The technic outlined by Dr. Pilkington will certainly do much to help the beginner in this important work, and the satisfaction of more closely simulating nature in our restorations has far-reaching compensations. What the beginner really needs after this is some experience, and of course that may be obtained by working with the problem. It is the observing mind that sees the true distribution of color in the teeth and one's sense of the beautiful impels one to imitate as closely as possible the true conditions of the individual case. With such a desire as a foundation, a procedure to obtain a correct reproduction will be readily worked out by using common sense methods in a rational way.

SOME SOURCES OF ERROR AND THEIR CORRECTION IN THE MAKING OF CAST GOLD INLAYS*

By F. S. MEYER, D.D.S., Minneapolis, Minn.

I SHALL omit all the details of cavity preparation and those sources of error on which a great deal of stress has already been laid, touching only those phases of the subject which are seldom mentioned.

All that I shall say on the subject of cavity preparation is: Seek as nearly parallel walls as will permit withdrawal of the wax model with ease. There are a great many reasons for this. Improvements in the casting technic, making it possible to cast a large mesioclusodistal molar inlay or a full shoulder crown apparently without shrinkage, permit us to seek more nearly parallel walls in our cavities than we were taught to obtain in the past. Parallel walls greatly increase the frictional resistance to dislodgment, permitting a much shallower cavity without any chance of the inlay's being loosened by the stress of mastication. That permits a great saving of tooth structure. It also permits us to dress down the cavosurface of an inlay within a millimeter of the margin, so that it can be seated with ease, without fear of dislodgment. This lessens the frictional resistance to the flow of cement. And this, in turn, lessens the pressure on the dentin.

Did you ever, after setting a large tight fitting gold inlay, have a patient come back and complain of tenderness to mastication? And what did you do? You relieved the occlusion by a little grinding. In a week or two, the patient came back again and complained of tenderness to mastication. This time you tested it to heat and cold and to tapping, apparently without any alarming response. And what did you do then? You ground some more, whether it was nec-

*Read before the Section on Operative Dentistry at the Midwinter Clinic of the Chicago Dental Society, Jan. 15, 1929.

essary or not, and told the patient that the tenderness would wear off in time. Perhaps it did and perhaps it didn't.

That tenderness of which the patient complained may remain for a year or more and the tooth remain alive. It is due to the pressure on the dentin. Remove the inlay and the tenderness will be gone the next day. Replace with a loosely fitting inlay, or one on which the whole cavosurface, except close to the margin, has been slightly relieved, and the tenderness will not reappear. Do not set an inlay that you cannot easily seat with finger pressure before it is cemented. Do not set a large inlay that has not been relieved to allow for the flow of cement, even though it may go to place with finger pressure. If you do, it serves as a wedge which may cause a tenderness of the tooth or, later on, the fracture of a cusp. We have all set a large tight-fitting inlay where we have restored the cusps. If we have polished such an inlay flush with the tooth before cementing, we have always found margins of the tooth exposed after cementing. The width of those exposed margins represents the amount that we have expanded that tooth from lingual to buccal aspect by using the inlay plus the cement as a wedge. Do you think that is a good thing for the health of the pulp?

Too tight a contact with an adjoining tooth is also a thing to be guarded against. It not only will cause an annoyance to the patient for some time after it is set, but it may also produce a very faulty gingival margin even though the inlay fits the cavity perfectly. We may apparently press an approximal inlay to place as far as the occlusal margins show at a glance, but place the explorer at the gingival, and we will find the margin of the tooth extended out beyond the margin of the inlay. When we properly relieve the contact, we find that the inlay becomes perfectly seated and fills out flush with the tooth.

The wax is another source of trouble. Wax expands on heating and contracts on cooling about 0.1 per cent for every 5 degrees change of temperature, more or less, this depending on the wax used. This change of the wax has worked to our disadvantage in the past. In explaining my technic later on, I shall try to show how we can take advantage of the elements of heat and cold in casting an inlay which shows apparently no shrinkage.

Imperfect margins of wax patterns are another source of annoyance. This is especially true of the gingival margins of step fillings in the bicuspid and molar regions. When we force the softened wax into such a cavity, there is a tendency on the part of the wax to flow away from the gingival margins. If we carve the wax flush with the tooth in this condition, the gingival margin is liable to be rounded. If we remove the wax pattern and add a softer wax to the gingival end before replacing, we distort the other margins in replacing. Either is bad technic.

After softened wax is forced into the cavity, it should be chilled with cold water. If the pattern is for a large mesioclusodistal molar inlay cut through the occlusal surface from the buccal to the lingual aspect with a hot instrument somewhere between points that will tend to bind when the inlay is cast, this will relieve some of the tension produced in the wax when chilled. When this wax again returns to the temperature of the mouth, it will expand some, which causes the pattern to fit loosely against the mesial and distal axial walls. This

helps a little to relieve the binding of a mesioclusodistal molar inlay when cast. To prove this, prepare a mesioclusodistal cavity in a porcelain molar tooth. In this, carve a wax pattern and chill in very cold water. Then, press down on the occlusal surface, and you will see water ooze out at the gingival margin. Cut through the occlusal surface with a hot instrument and hold the mesial and distal sides of the wax pattern down to place until it cools. If it is chilled again, no water oozes out at the gingival.

When the tension of the wax pattern has been thus relieved, cut out the wax between the contact point and the occlusal surface, leaving a V-shaped opening. Place a matrix between the wax and the adjoining tooth so that the bulk of wax lies between the matrix and the gingival margin of the cavity. The matrix must extend just beyond this margin. A warm instrument shaped for the purpose is placed between the matrix and the adjoining tooth, at or beyond the margin, warming the matrix and, through it, the wax near the gingival margin. The matrix and the wax pattern are held in place with one finger, and this instrument is drawn toward the tooth until the matrix reaches it at the gingival margin, forcing the softened wax into the cavity and sealing up all the defects. There are two of these instruments, one for the buccal and one for the lingual aspect. The matrix is removed and the slight remaining overlap of wax is then cut away by any technic that you are in the habit of using.

The correction of the other margins is very simple. I say simple; and still I have found few men who know how to make a perfect correction of a faulty wax margin. Never try to melt wax into a crevice between a wax pattern and a tooth. It will not flow in to any great distance, and where it does flow, it either pulls away from the tooth on cooling, if the tooth is moist; or it sticks to the tooth, if the tooth is dry. Further, the correction is often so superficial that we may polish through it when finishing the inlay. A hot flat wax instrument is forced into the wax pattern 2 mm. from the defective margin. When the wax has cooled a trifle, with this same instrument the softened wax is forced toward the margin until it laps out over it. Then the crevice thus produced is filled with melted wax, and when sufficiently cooled, the whole mass of softened wax is compressed toward the tooth. By this means, we get a perfect correction, and the wax will not stick to the tooth even if the tooth is dry. In carving a wax pattern, it frequently occurs that we find the wax not quite flush with the tooth. If we add a little wax, it is liable to peel near the margin. If the foregoing technic is used, it will never peel. It is quick, easy and sure.

In taking impressions for crowns and inlays by the indirect method, when we force the band or cap filled with warm modeling compound to place, we find some difficulty in removing the impression. This may be due to the compound's sticking to the tooth, to faulty preparation or to the sudden constriction of the tooth beyond the shoulder. I always coat the tooth with soapsuds before taking any impression, and the stickiness is thus obliterated. Furthermore, the soap is easy to wash off. When taking an impression for a jacket crown, if we cut two little holes through the sides of a copper cap close to the end and through these thread a loop of silk tape that we can just put a finger through, we will have no trouble in removing the compound impression. It often happens, on removing the impression, that certain defects are found in

the compound at the shoulder or just beneath the gum. They are due to air pockets rather than gum tissue, and they are very annoying. With a small instrument, a little hot compound is added in those pockets or defects, the correction being made as nearly perfect as possible, but a little deficient, if anything. Then, the tooth is coated with soapsuds again and the impression replaced on the tooth, always cold. If we replace the compound impression while warm, it will be ruined.

With a hot air syringe or chip blower, a blast of hot air is thrown on the impression until the compound softens, just enough pressure being given it to force out a little compound at the gingival margin. It is then chilled, and the impression is sure to be perfect. Before forcing the softened wax to place on the amalgam or cement model, the model is always warmed in hot water. If not, the wax chills and does not form so close an adaptation to the model as is possible. When the wax crown is carved and chilled, on examining the gingival end, we nearly always find the margin defective because the wax shrinks and pulls toward the occlusal aspect. A slight overlap will conceal this defect. Therefore, we should always be sure to correct this margin by the above described technic before removing the wax pattern. This technic applies to inlays as well as to crowns by the indirect methods.

The sprue formers and crucible formers have also given us some trouble. It often happens that the mounted wax pattern loosens from the crucible former when being painted with investment. A little beeswax is melted into the hole in the crucible former. This wax is soft enough so that we can easily force a sprue former into it, and stiff enough so that it will hold the sprue former rigidly without any danger of its loosening. Most of the crucible formers fit the rings so loosely that water or investment leaks out from the base of the rings, which causes a settling of the investment. This tends to cause distortion of thin wax patterns, especially if the investment is warm. If the ring can be made to fit tightly into a groove on the crucible former filled with beeswax, the joint will be perfectly sealed and we may safely pick up the mold by grasping the ring.

Possibly the greatest source of trouble comes in trying to duplicate the wax pattern in gold. And here I am going to make a radical statement: A perfect reproduction in gold of a wax pattern will probably never be made. In order to make such a reproduction, we should either have to produce an alloy of gold which would neither shrink nor expand on cooling from the molten state, plus a wax and an investment which would not change with a change of temperature, or we should have to have an investment which offered no resistance to the shrinkage of gold and then expand the wax pattern to compensate fully for that shrinkage. But it is not necessary to cast an inlay that fits perfectly surface to surface. And even if we could, we should have to relieve it to allow for the flow of cement.

To explain the point more fully: We have all cast some mesioclusodistal molar inlays that went nearly to place the first time we tried them in the teeth. If we will remember, they probably all had thin occlusal and bulky mesial and distal portions. When such an inlay passes from the molten to the solid state, and especially is this true if the mold is cold, the thin occlusal portion starts to congeal before the mesial and the distal portions. It completes a great part of its

shrinkage before the mesial and distal portions are hard enough to overcome the resistance of the investment. Hence, the shrinkage of the inlay from mesial to distal aspect, will be less. The opposite is true if the occlusal portion is bulky and the ends are thin. Generally speaking, a thin inlay shrinks less than a bulky one. As all inlays are more or less irregular in shape and as the investment resists the shrinkage of the gold between points that tend to bind, and not between other points that do not tend to bind, as from gingival to occlusal aspect, it is easy to understand why a perfect inlay cannot be cast.

There are numerous investments on the market, all varying in their formulas, the quality of their ingredients and the manner of their use. The principal ingredients of all these investments are plaster of Paris and silex. In the so-called carbonization technic, a relatively low percentage of plaster is used, producing a mold which does not get very hard and offers comparatively little resistance to the shrinkage of gold. In this technic, the mold will stand a comparatively higher degree of heat without much danger of disintegration. This has, of course, some advantages. In the quick elimination technic, a relatively large percentage of plaster is used, producing a much harder mold, which offers a great deal of resistance to the shrinkage of the gold. This also expands a little more on heating because of its higher plaster content. When the high plaster content investment is used, the wax must be eliminated before the moisture because the mold will not stand the high heat necessary to carbonize the wax.

To Dr. Knapp belongs the credit of first bringing out the quick elimination technic in such a way that the profession could use it. He steamed out the wax by means of the free water in the mold, using a higher heat than we had been using. This technic has produced some beautiful inlays; but, in most hands, the percentage of failures is too great and there is no adequate provision made to compensate for the shrinkage of gold. The technic which we have tried to advance brings in the element of heat. If the investment is mixed at a temperature 50 degrees above room temperature and maintained at that temperature until it sets, the wax model will be expanded 1 per cent. This compensates for most of the shrinkage of the gold. To accomplish this result, a technic has been worked out as follows:

A thermostatically controlled device which we have called a wax expander, containing compartments for water, investment rings and a depression for seating an investment mixing bowl, is set to reach a temperature of 170 degrees. Hot water from a bottle in the wax expander is mixed with a slow-setting low-plaster content investment of room temperature and allowed to remain on the wax expander until the inner investment is mixed and painted on the wax pattern. The temperature of the water used for the outer investment must vary with the shape and size of the wax pattern. Generally speaking, the thinner or the smaller the wax pattern, the lower the temperature of the water must be. A full crown requires the full heat of the water, a large mesioclusodistal molar inlay less, or about 140 degrees. A thin mesioclusodistal molar inlay, small inlays and three-quarter crowns require the least. In general, the bulkier the inlay, the hotter the water must be. If the water is 160 degrees and the outer investment is the temperature of the room, the resulting temperature will be between, or about, 115 degrees.

To return to the inner investment: On one end of a large glass slab, about one half cubic inch of inner investment is placed. At the other end, a quantity of room temperature water covers a surface about the size of a dollar. Enough of the inner investment is mixed with the water so that we get a mixture as heavy as we can conveniently paint it on the wax pattern with ease. This is done with a large cement spatula much as cement is mixed. Then a little of this mixture is drawn aside and more investment powder added to it until it is as heavy as it is possible to paint it on the wax pattern and vibrate it to place. This heavier mixture is then painted on the cavosurface of the wax pattern (this surface should always be up, if possible) and vibrated to place by rasping the crucible former with a coarse file. This vibrating causes the water and the bubbles to rise and the denser parts of the investment to settle.

This produces the hardest and the smoothest mold on the cavosurface of the wax pattern where we most need it. A little more of the heavier inner mixture is added, followed by a slight rasping. The outer surface of the wax pattern is then painted with a slightly thinner inner mixture to the thickness of about one eighth inch. This is also flowed down over the sprue former and the crucible former. A hot ring is then taken from the wax expander and placed on the crucible former; the warm outer investment is poured, and the mold is placed on the wax expander. The outer investment should be warm enough that the whole mold, including the wax model, will arrive at the desired temperature as soon after the investing as possible. If the wax pattern is increasing its temperature and expanding while the investment is setting, there is a great liability to some distortion. It is allowed to set for forty minutes and to reach a maximum temperature of 120 degrees or less before setting. An x-ray timer is very convenient to notify one when the time is up for each step.

The thicker the layer of inner investment over the wax pattern, the less the heat absorbed from the outer investment before it sets. The longer it takes to paint the wax pattern with the inner investment, the quicker the inner investment will set after being painted on the wax pattern, and, therefore, the less the heat absorbed from the outer investment before it sets. It is easy to see from the foregoing that every individual will not use the same temperature of water to obtain the same result.

There are several reasons for using a double investment: to get the heaviest possible high plaster content mixture which cannot be poured, next to the wax pattern; to get a more porous outer investment, which will facilitate the escape of air in casting, and to get a lower plaster content outer investment which will stand the high heat of elimination without disintegration. As we all know, some are now attempting to cast full dentures without shrinkage, by mixing the investment as thick as putty to produce a hard, resisting surface, and laying the wax pattern over it. For inlays, we cannot do that, but we can approach it by using a double investment with a heavier plaster content in the inner mixture.

Now comes a critical stage in the casting process: the elimination of the wax and the moisture. Nearly every man has a variation in the process. As we are using the high-plaster content investment, we must eliminate the wax before we eliminate the moisture. To supply the necessary water to steam out the mold, I resorted to a cylindrical boiler

so constructed that when the mold was put into it with the crucible outward, the base of the mold, resting on a rubber washer, sealed the water in.

For some time, I experimented with a very small boiler and utilized every bit of the water to steam out the wax in the mold, I resorted to a cylindrical boiler and doubled it again. The boiler that I am now using is therefore four times the size of the original. Having a large reserve of water, I could reduce the steam pressure and lengthen the time of elimination. This reduced the violence of the erupting steam and caused it to be condensed to water in the crucible, which had the appearance of boiling.

The boiler is now heated by placing it in an electric eliminator and the expanding water and steam are forced through the mold with less violence, carrying the wax, as well as any small particle of tooth structure or other sediment in the wax, out through the sprue, leaving the mold clean.

When the force of the steam becomes great enough that the condensed water in the crucible has the appearance of boiling so violently that we cannot see the sprue, it is time to remove the boiler from the eliminator. Continuing the process a little longer will do no harm, since the escaping steam will keep the pressure down to 15 pounds or less, at the temperature of the eliminator which I am now using. The steam pressure will vary some, this depending on the proximity of the wax model to the base of the mold and the density of the investment. This process takes about six minutes or less.

The boiler is then taken from the eliminator and placed under the cold water tap in such a position that the cold water strikes the lower part of the boiler before the water in the boiler touches the whole base of the mold. The boiler may then be turned upside down to empty the water from the crucible. If the boiler should be turned upside down before cooling, the steam would rise to the bottom and force the water down through the mold with considerable violence and often ruin it. When the steam in the boiler has been condensed, the mold is removed and placed in the above mentioned eliminator, which reaches a temperature of about 800 degrees, and the moisture is driven out. This takes about sixteen minutes. The x-ray timer is set for the minimum time required for the elimination and, from then on, the mold is subjected to the mirror test.

If we are to cast an inlay, the mold is removed when a quickly disappearing cloud appears on the mirror. If casting a crown or a three-quarter crown, we should wait until about half a minute after all the moisture is gone. If we do not wait a little longer for a crown, we are liable to have a hole through the occlusal portion. We have all cast crowns or three-quarter crowns and had holes through the occlusal portion or up into the sprue and have wondered why. This trouble has erroneously been laid to a great many things such as oxids or carbon in the gold, gas absorbed from the blow pipe or trapped air in the mold.

When a wax crown has been invested and we are eliminating the moisture from the mold, the first part of the mold to be freed from moisture is that part between the wax patterns and the ring. We shall call it the outside. When all the moisture has been eliminated from the outside, the heat cannot pass through the space left by the eliminated wax as long as there is vapor there. Consequently, it cannot reach the core of investment produced by the inside of the wax pat-

tern, without passing around the gingival end of the wax pattern. It is therefore important that, in the making of a crown, the wax pattern be placed as near or nearer the base of the mold than it is to the ring, and that heat should reach the mold from this end as well as from the outside. Even then, the last place for the wax or moisture to be eliminated is at the end of this core. If there is a projection of investment from this core into the space left by the eliminated wax, such projection as is produced by a cusp of a tooth or a deep pit on the occlusal surface or a sharp projection in the cavity, that projection is kept cool by the evaporating moisture, and hence is the last place to be freed from moisture and, in the carbonization technic, from wax as well. When the molten gold strikes this projection, the slight uneliminated moisture or wax is suddenly turned to a gas which forces the gold back and sometimes produces a hole through the crown. As this core is protected from the heat longer than the outside, the cast crown is likely to be smoother on the inside than the outside. It is well to wait from a half a minute to a minute before casting. If this technic is carried out correctly, every full shoulder crown or mesioclusodistal molar inlay should go to place on any model without retouching.

Since this paper was written, an idea has come to me for perfecting this technic. Today, we are all familiar with two well known facts about plaster of Paris. When heated to a certain temperature, it will disintegrate; also, when heated, it will show an expansion between some temperatures and a contraction between other temperatures, but always a contraction when cooled from high temperatures. As we can eliminate all the wax with hot water and steam or with steam alone, we should be able to eliminate the moisture at the highest temperature which is short of plaster disintegration where the plaster shows the greatest expansion. I found that possible, but the length of time necessary was objectionable. I also found that I could eliminate most of the moisture at the same temperature that I was then using in about twelve minutes and then place the mold in the highest temperature at which the mold showed expansion without disintegration and there eliminate the remaining moisture in five or ten minutes. Hence, it is now possible to invest a wax model, and eliminate the wax in from thirty to forty minutes, in two hours or the next day, if we wish. We may then eliminate the moisture by placing the mold in the eliminator for twelve minutes and on the eliminator for ten minutes, two hours or as long as we wish, without ruining the mold. The casting is sure to fit. There is more guesswork as to when to eliminate and when to stop the eliminating process and cast.

The electric eliminator with which I have done most of my experimenting makes provision for the elimination of only one wax model at a time. Finding that a Chicago firm had developed the only electric eliminator in which the temperature is perfectly controlled up to 700 degrees, I determined to experiment with it for technic. The result was very favorable. The boiler, if placed within the eliminator when up to full temperature, will eliminate the wax in seven minutes. When not up to full temperature, we get faulty elimination unless we hold it over a Bunsen burner for a minute or two to finish. When the boiler is placed within the eliminator, the heat above the crucible causes the water to boil, producing an appearance similar to that when the steam is forced through. This may deceive if one is not aware of

it. The mold is then placed on the grate within the eliminator for twelve minutes, and most of the moisture (down to where only a cloud would appear on a mirror if placed over a sprue) is eliminated. It is then placed on the top of the eliminator, where it will reach a maximum temperature of 300 degrees. Here, it should be left for fifteen minutes, or as much longer as is convenient for the operator. If we should wish to leave the office, we would be perfectly safe in leaving the mold on the eliminator over night, provided the current was left on. The casting would not be ruined.

This same Chicago firm has promised to develop an eliminator a little better suited to this technic, which I hope will be ready for the profession within a few months.

For some time, I used the quick elimination technic. I obtained some beautiful castings, but any percentage of failures was too great. The time between underelimination and overelimination was less than a minute. Too much of the personal equation entered. As I cut down on the heat and lengthened the time of elimination, it became more difficult to force out the wax. It was then that I resorted to steam elimination.

DISCUSSION

Stanley D. Tylman, Chicago, Ill.: The presentation which Dr. Meyer has made is of especial interest to us as it offers an explanation of some of the most common and frequent mishaps in connection with the small casting. Heretofore, not knowing where to place the blame for our failures, we have listened to the various panaceas offered as relief measures. Some asserted that it was the wax used; others assured us that if their particular investment or casting machine were employed, inlays would fit. Gold manufacturers believed that the kind of gold alloy used might have some bearing on the result. Groping in the dark, we tried them all, still without success. It remained for Dr. Meyer to blaze the trail to the apparent difficulty and its solution. It was not so much the wax, but rather the manner in which these materials were manipulated. Quite logically, wax and its manipulation received his first consideration. The technic advocated by him in patterns for large cavities will relieve the tension caused by the chilling of the wax. Likewise, by his method, we get an accurate and definite gingival impression in the wax model. Up to this point, most men obtained uniformly good results. From there on, most of us failed. Dr. Meyer makes what seems at first to be a very discouraging confession when he states that "a perfect reproduction in gold of a wax pattern will probably never be made;" then he tells us quickly why a perfect reproduction is not practical. Those of you who have seen the several clinics which he has given in recent years will appreciate his modesty for, by his wax expansion technic, he has produced castings which for smoothness, reproduction and accuracy are perfection personified. There are some points of the presentation which I should like to stress. The matter of tooth tenderness following the setting of an inlay or bridge attachment is one of these. How often have we not experienced this same condition? Grinding did not help, and often the inlay was removed. Sometimes, the tenderness was tolerated, and the pain in the course of weeks subsided and gradually stopped. What happened? Men who are particularly interested in the pulp and its problems will tell you that response of a tooth to thermal and electrical tests is not indicative of its being normal. It may be vital, yes; but a degenerative process may have set in as a result of the compression of dentin and pulp caused by the swaying of the casting over the preparation. How often this has happened in abutment teeth with a subsequent condemnation of fixed bridgework. Had the pattern been expanded, there would not have been this vicelike gripping of the tooth by the casting. We have been using and teaching the students the method as presented by Dr. Meyer, and in a tabulated record of 1,000 consecutive cases in the hands of students, the percentage of failures has been less than 1 per cent.

HETEROTOPIC OSSIFICATION IN THE PULP: A CONTRIBUTION TO RESEARCH ON THE BIOLOGY OF THE DENTAL PULP*

By EDGAR D. COOLIDGE, B.S., D.D.S., F.A.C.D., Chicago, Ill.

IN a study of histologic sections of the jaws and teeth of rats fed on different diets, some unexpected and interesting things were found. In the case here presented, some very unusual calcifications appear in the center of the pulp which differ widely from secondary dentin or pulp stones. In a search through the literature, little was found that described calcifications of similar appearance.

Figure 1 is a photomicrograph of the upper incisor of a rat. The convex surface, which is the labial surface of the tooth, shows a white layer, a space formerly occupied by the enamel, beneath which can be seen a layer of dentin only partially calcified. On the concave surface, no enamel can be seen, and a thinner layer of dentin appears here than is seen on the labial surface. On the lingual, or concave, side, cementum covers the surface of the dentin. The pulp at the base of the tooth on the right of the illustration is normal in appearance but toward the center shows the presence of certain changes, which will be later described. Nearer the cutting edge, on the left, pulp degeneration and necrosis are seen.

The incisor of the rat is a continuously growing tooth. It grows on an average of 2 or 3 mm. a week. The same amount of tooth substance must be worn away on the cutting edge by gnawing. By this process of tooth eruption, every stage of tooth development can be found, beginning at the central end and extending toward the cutting edge. The latter is the oldest part of the tooth, while at the central end new dentin and enamel are continuously forming. The central end of the tooth is a fixed point and the entire tooth is continuously growing outward from that point. The dentin becomes thicker and thicker toward the incisal edge and normally closes the pulp chamber a few millimeters before the incisal edge is reached, so that, by the occlusal wear of the incisal edge, there is normally no exposure of pulp tissue. On the central end of the tooth where the new building of the tissues takes place, Hertwig's epithelial sheath (Fig. 14) is always present; while, in the human jaw, Hertwig's epithelial sheath disappears as soon as the full length of the root dentin is completed.[1] The presence of Hertwig's epithelial sheath at the central end of the tooth is the indication of continuous development. In the later consideration of the findings, the importance of this will be more fully discussed.

The continuous growth of the rat's incisor makes this animal valuable for research. The effect of any nutritional dis-

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1. Orban, Balint: Dental Histology and Embryology, Chicago: The Rogers Printing Co., 1928.

turbance will be evident on the tooth mostly as a disturbance in calcification and probably in the amount of dentin and enamel formed. This rat was used in a feeding experiment for several months. It was fed entirely on polished rice, and during this time, this tooth showed an average growth of 1.5 mm. a week. Howe, Grieves, McCollum and others have reported extensively upon the effect of defective diets on rat's teeth.

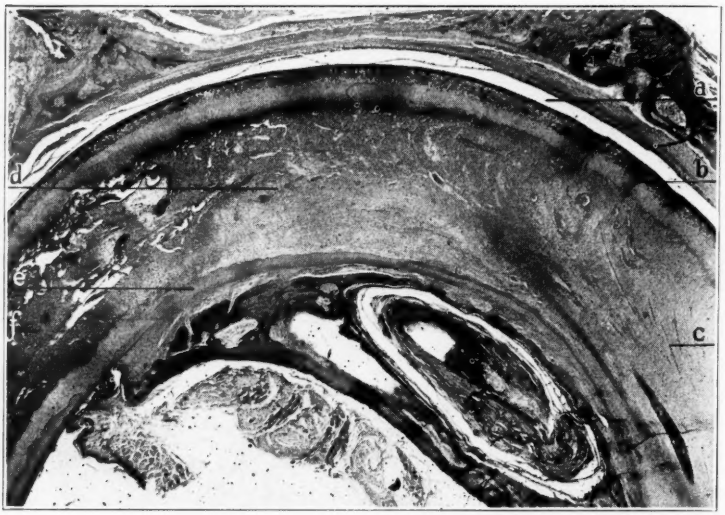

Fig. 1.—Upper incisor of a rat. *a*, enamel; *b*, labial dentin; *c*, central end of the pulp; *d*, middle portion of the pulp; *e*, lingual dentin; *f*, incisal end of pulp. The central end of the pulp is quite normal; the middle portion shows fibrous degeneration and bonelike formations; the incisal end of the pulp shows necrosis.

The relation of the growth and calcification of incisors of rats to diet has been recently reported by Orban.[2] In this first figure, very poor calcification of the dentin can be seen. On the labial side, only a thin layer of the whole dentin, just below the enamel, is homogeneously calcified. Then, a layer of calcified globuli follows, and the inner half is entirely uncalcified. The lingual wall is much thinner than it would be under normal conditions and the calcification is extremely poor. Owing to the difficulty in dentin building, the incisal edge is not closed, but the pulp is widely exposed, as shown in Figure 2. The pulp tissue near the incisal edge is necrotic and shows toward the center of the pulp chamber enlarged blood vessels partly filled with coagulated blood.

In Figure 3, located in the center of the pulp (Fig. 1 *d*), several calcified areas are seen. Surrounding these areas is a homogeneous matrix just beginning to calcify. No star-shaped pulp cells can be seen in the surrounding tissue, but the cells are long and shaped as

2. Orban, Balint: Nutrition and Teeth, J. A. D. A., 14:1619 (Sept.) 1927.

common connective tissue cells, or smaller cross-sections of the same cells are seen. Within this calcified substance are seen a few connective tissue cells which have become entrapped and surrounded by this matrix. In the calcified areas can be seen embedded connective tissue cells which give this substance a bonelike appearance. Numerous blood vessels somewhat dilated in appearance are seen in the upper part of the picture. In order to understand the significance of the finding of bonelike substance in a pulp, the normal tissue of the pulp must be studied. It is a known fact that the pulp never builds or very rarely builds anything else than dentin or a dentinlike substance. The dentin is built by highly specialized pulp connective tissue cells. Highly specialized cells are capable of producing only the special kind of tissue for which they have been specialized. If any kind of cell changes its character and produces a type of tissue other than that for which it was intended, it may be spoken of as metaplasia. The question of metaplasia in general as well as the question of metaplasia of the pulp is still a much debated subject. It is not the intention of this paper to presume to settle the question of metaplasia but to present a finding which seems to have a relation to it.

In the study of the specimen of several hundred rats fed on defective diets, and especially upon polished rice, no other case of this kind was found.

Fig. 2.—Incisal edge of the tooth shown in Figure 1. The pulp is exposed and necrotic.

Figure 4 shows the pulp nearer the central end or base of the tooth, which is the last developed. This pulp appears to be normal, as can be seen by the many normal pulp cells, starlike in shape, with protoplasmic processes extending outward to connect with other similar cell processes. Between the cells, fine fibers cross each other in all directions.

An oblique section of a small vessel filled with blood cells and also an oblique section of a nerve bunder can be seen in the field.

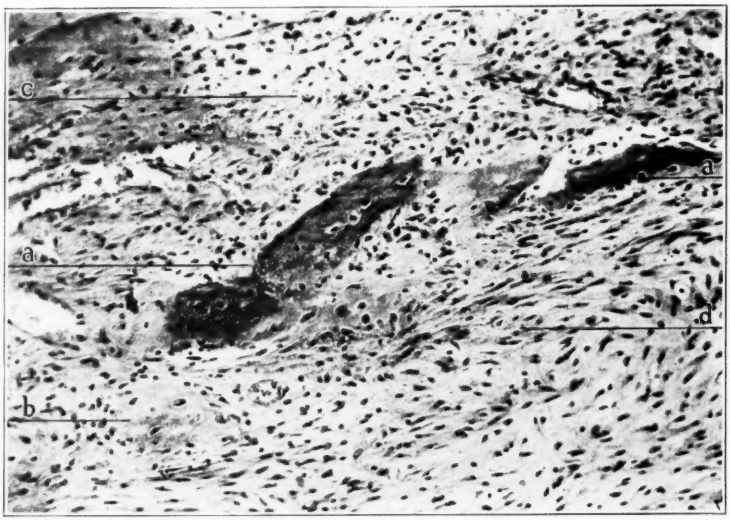

Fig. 3.—Higher magnification of the middle section of the pulp showing bonelike formation. *a*, bonelike calcified substance; *b*, osteoid tissue. In the upper part of the illustration, *c*, are many blood vessels. In the lower, *d*, the issue is more fibrous and scarlike.

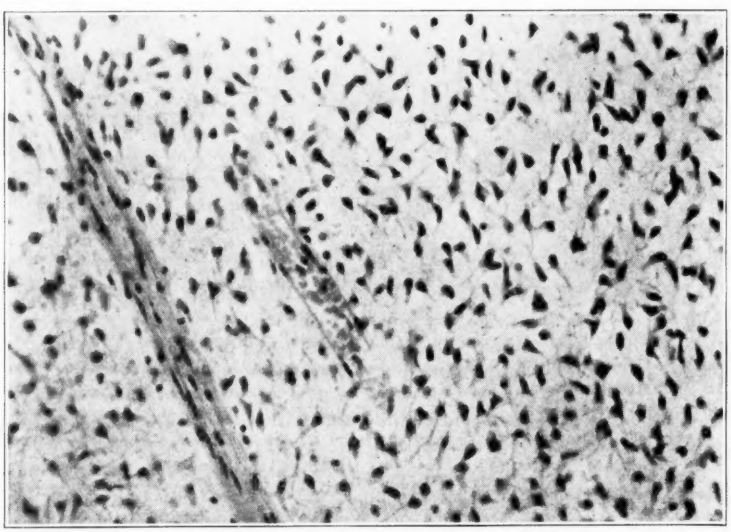

Fig. 4.—Higher magnification of the central end of the pulp; normal pulp tissue. Starlike cells, a nerve bundle and a blood vessel cross the field.

In Figure 5, a higher magnification shows the cells and their processes embedded in the pulp matrix more distinctly. The thin walls of the blood vessel composed of a single layer of endothelial cells are plainly seen, and a small part of the nerve fiber is included in the lower left corner of the illustration. If we follow the tooth up to the center of the pulp, changes in character of the tissue can be seen.

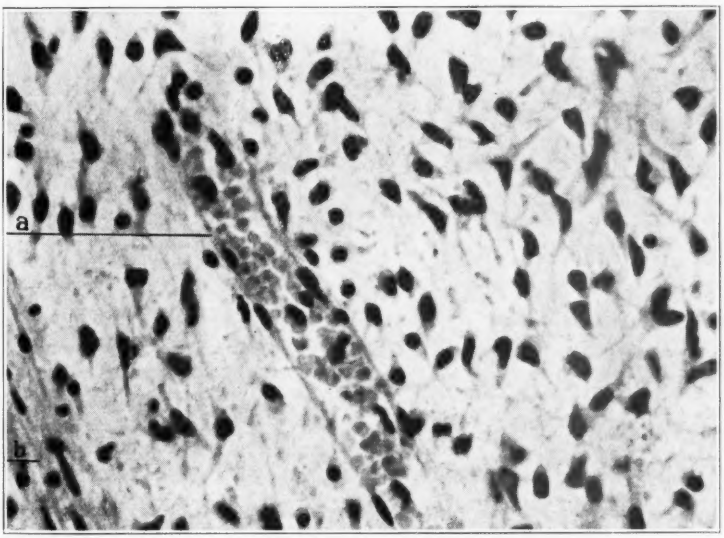

Fig. 5.—Higher magnification of Figure 4, showing normal pulp tissue. *a*, blood vessel; *b*, nerve fiber.

Figure 6 shows the character of the central part of the pulp. If one compares this figure with Figure 4, which is the same magnification, a striking difference can be seen. The cells are fewer in number and different in shape. The intercellular substance, probably the collagenous matrix, occupies more space. The cells are elongated and show more of the character of common connective tissues. Only a few starlike pulp cells may be seen. The normal pulp has embryonic tissue characteristics, with its starlike cells, while the tissue shown in Figure 6 is more scarlike.

In Figure 7, we see the same tissue as in Figure 6, only with more surrounding tissues. In the lower part of the illustration, the lingual wall of the tooth is seen bordered by the periodontal membrane on one side and the scar-like pulp tissue on the other. On the side toward the periodontal membrane, a very thin layer of cementum covers the dentin. The inner border of the dentin is of unusual appearance. It is not a straight line as is normally seen, but shows a scallop-like border. Odontoblasts are entirely missing; and from the connective tissue cells lying along the border, it is difficult to tell whether they are build-

ing or resorbing. The scarlike pulp tissue seems to be arranged in bundles, which is not characteristic of normal pulp. In the upper third of the picture, the previously mentioned bonelike structures appear. At different places in this central section of the pulp, these structures appear in different stages of formation.

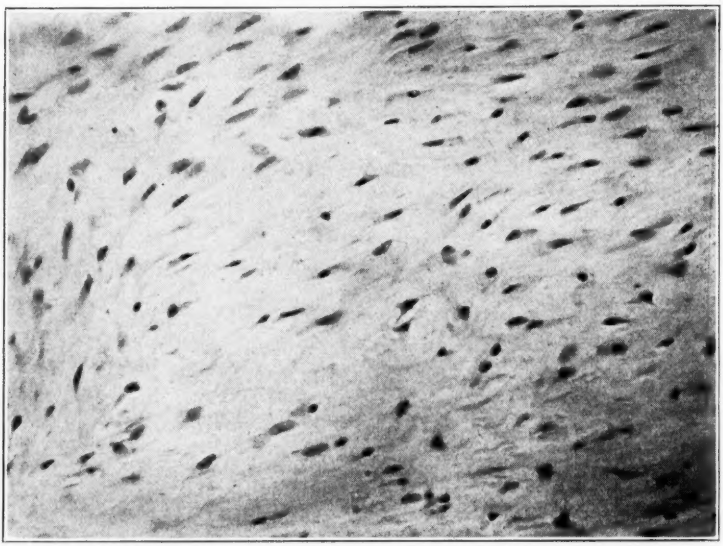

Fig. 6.—Higher magnification of the middle portion of the pulp. Cells less numerous and fibrous intercellular substance occupy most of the space. The cells seem to be more like common fibroblasts with only a few starlike pulp cells present.

At the left side of the picture at *d* can be seen a homogeneous mass with enclosed cells. This, we believe, marks the starting point of the development of the bonelike substance. Higher magnification of one of these hyaline areas is seen in Figure 8. In this picture can be seen the different types of tissues, which helps us in the interpretation of the origin of this homogeneous mass. In the lower right angle of the picture, only a few cells are seen, but the fibrous intercellular substance, probably of collagenous nature, occupies the space. The fibers of this intercellular substance may be followed as they enter and become gradually lost in the homogeneous mass.

In Figure 9, one further step in the development of the bonelike structure is seen. In the center of the homogeneous mass, calcium salts have been deposited and are seen as little dark spots. In the specimen which is stained by hematoxylin-eosin, the calcified center is stained dark blue, while the margin, being uncalcified and hyaline, is stained pink. There is no definite line between the homogeneous mass and the surrounding connective tissue.

Groups of fibers can be seen entering and disappearing in the homogeneous hyaline mass.

If we view a larger area, as seen in Figure 10, we can see that the enclosed cells appear very much like the cells enclosed in bone tissue. The central part of this mass seems to be entirely calcified, while around the margin lies an uncalcified area which resembles osteoid tissue. Around the enclosed cells can be seen a lighter stained ring, which indicates that a less calcified area surrounds the cells.

In these few illustrations, the different stages in the development of the bone-like mass in the pulp has been quite clearly shown. We have seen the changes from the normal pulp to one of few cells and much intercellular substance. We have seen the intercellular substance change to a hyaline mass in which cells have become enclosed within the mass.

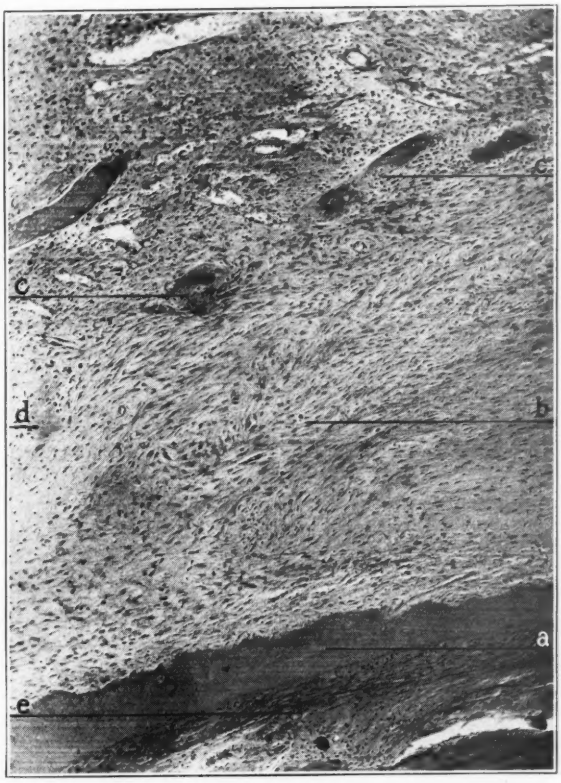

Fig. 7.—Middle portion of the pulp. *a*, lingual dentin; *b*, fibrous connective tissue in place of normal pulp tissue; *c*, bonelike substance; *d*, osteoid tissue. The odontoblasts are missing. The border line of the dentin toward the pulp is irregular. *e*, periodontal membrane.

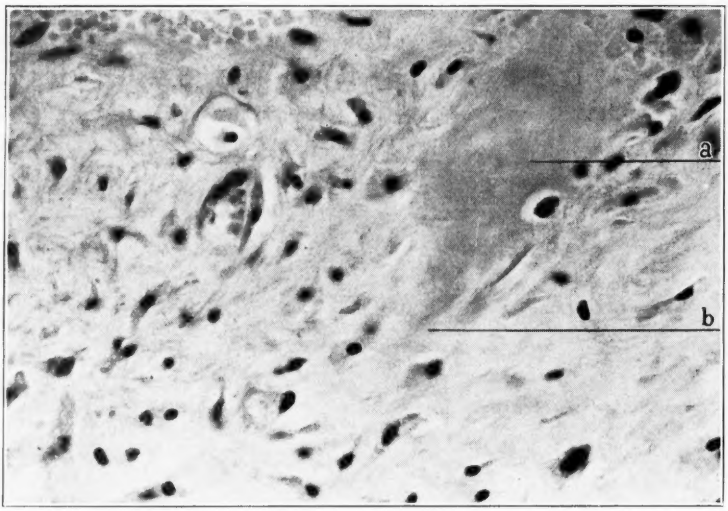

Fig. 8.—Hyaline degenerated area of the pulp at *a*. Bundles of collagenous fibers *b* can be traced into the osteoid tissue.

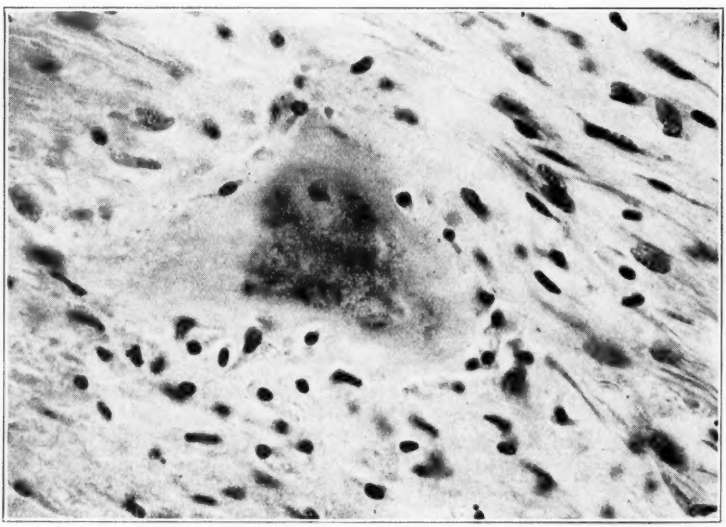

Fig. 9.—Deposition of calcium salts in the center of a hyaline degenerated area. Cells become entrapped in the osteoid substance.

We have seen that the hyaline masses become calcified by a deposit of calcium salts within the center of the mass. In this way, bonelike substance has developed within the center of the pulp.

As was mentioned above, if any type of tissue changes its character and function and produces a type of tissue other than that for which it was intended, the process may be spoken of as metaplasia. Kaufman states, "If ready differentiated tissue changes its character as well as morphology and functional relation into another tissue, it is spoken of as metaplasia."

It is generally considered that not only does periosteum and endosteum have the power of building bone in developed organisms, but that common connective tissue may acquire the power to build bone under certain circumstances. Maximow[3] claims that everywhere in the whole organism are undifferentiated cells with embryonic powers which may under certain circumstances display different powers. We do not believe that, in this case, such functions have been displayed. It seems quite probable that, owing to nutritional disturbances, certain degenerative changes took place in the pulp. Hyaline degeneration resulted and calcification followed. Borst[4] claims that this kind of tissue is a false bone, but from this bone, real bone may develop. An illustration of similar bone formation is here shown from Borst's contribution in Aschoff's Pathology (Fig. 11). The description of the picture is as fol-

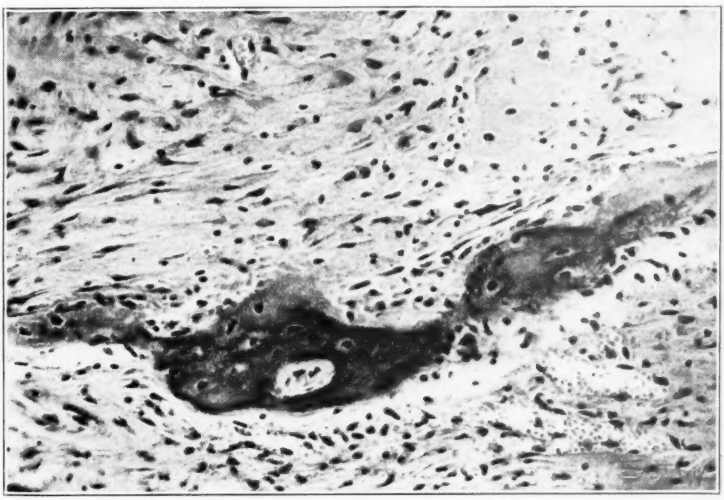

Fig. 10.—Larger area of bonelike substance. Enclosed cells appear like bone corpuscles. The outer border of the bonelike substance is uncalcified.

3. Maximow, Alexander: Morphology of the Mesenchymal Reactions, Arch. Path. & Lab. Med., 4:557 (Oct.) 1927.

4. Borst, M.: Aschoff, Pathologische Anatomie, 1928, p. 652.

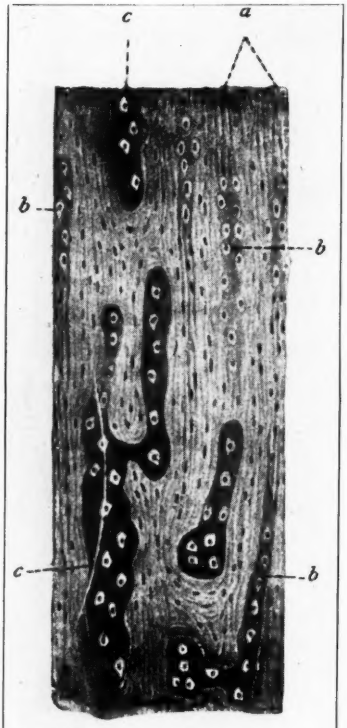

Fig. 337. Metaplasie von Bindegewebe in Knochen. Aus einem Fibrom der Haut des Oberschenkels. (Vergr. 66 : 1.) *a* Züge fibrillären Bindegewebes, unter Homogenisierung der Zwischensubstanz in Knochen übergehend; *b* osteoide Bälkchen; *c* verkalkte, fertige Knochenbälkchen.

Fig. 11.—Illustration from Borst (Fig. 337, Aschoff's Pathology Vol. 1, 1928: "Metaplasia from Connective Tissue into Bone" from a fibroma of the skin of the thigh.) *a*, bundles f fibrous connective tissue passing over into bone under homogeneous transformation of the intercellular substance; *b*, osteoid trabeculae; *c*, calcified ready bone trabeculae.

lows: "Metaplasia from connective tissue into bone. From a fibroma of the skin of the thigh. (Enlargement 66:1) *a*. Bundles of fibrous connective tissue passing over the bone under homogeneous transformation of the intercellular substance; *b*. osteoid trabeculae; *c*. calcified, ready bone trabeculae." If this picture from Borst is compared with our illustration, it will be seen that they resemble each other in many respects.

As to the cause of metaplasia, according to Borst, "the occasion to metaplastic processes is given through changes in the conditions in which the cells are living." Such changes are chronic inflammatory processes, trophic changes, changes in function and chemical and mechanical influences. In this animal, the cause leading to the heterotopic building of bone may be due to disturbances brought about by feeding with polished rice. It is difficult to determine whether the feeding experiment brought about changes in the entire metabolism of the rat and thus produced a metaplasia in the pulp tissue or whether the nutritional disturbance reduced the building of dentin so that the pulp became exposed and abnormal bone formation resulted from pulp irritation.

Euler[5] has described metaplasia in the pulp of human teeth. In his case the entire coronal portion of the pulp chamber in a third molar of a patient 38 years of age was filled with bonelike substance. In the apical portion of the root canals, he describes somewhat degenerated odontoblasts. He claims that only that pulp can become metaplastic in which the cells have the ability to react with a regular calcification, the odontoblasts excepted. The degeneration of the odontoblasts can be the result of a local nutritional change. A similar case has been described by Zemsky[6] recently.

5. Euler, H.: Metaplasia of the Pulp, Vierteljahrsschr. f. Zahnheilk., 1921, p. 303.

6. Zemsky, J. L.: Root Resorption and Its Clinical Significance, J. A. D. A., 16:520 (March) 1929.

Höjer and Westin[7] assert that findings like that of Euler may be explained by changes due to a scorbutic diet. In guinea-pigs affected by scurvy, a fibrous change of the pulp is often found. The odontoblasts disappear and bone becomes deposited on the surface of the dentin. Whether the case presented here can be compared with those observed by Höjer and Westin and others as affected by scurvy, we cannot decide. Some investigators claim that rats are not susceptible to scurvy and, as formerly stated, we did not find any other occurrences of similar bone formation in all this series of rats.

In the same pulp, nearer to the central end, another peculiar formation can be seen in Figure 12. This, which appears to be secondary dentin, is sometimes deposited free in the pulp tissue as in Figure 12; or it may be attached to the wall of the dentin as seen in Figure 13. This substance closely resembles denticles or pulp stones found in human teeth. Fridrichovsky[8] has reported denticles or pulp stones found in pulps of rats' teeth and has called attention to the presence of groups of epithelial cells in close relation to these areas of calcification. This observation is substantiated in this case, as can be seen in Figures 12 and 13. The significance of epithelial rests in the pulp tissue in their relation to denticles and

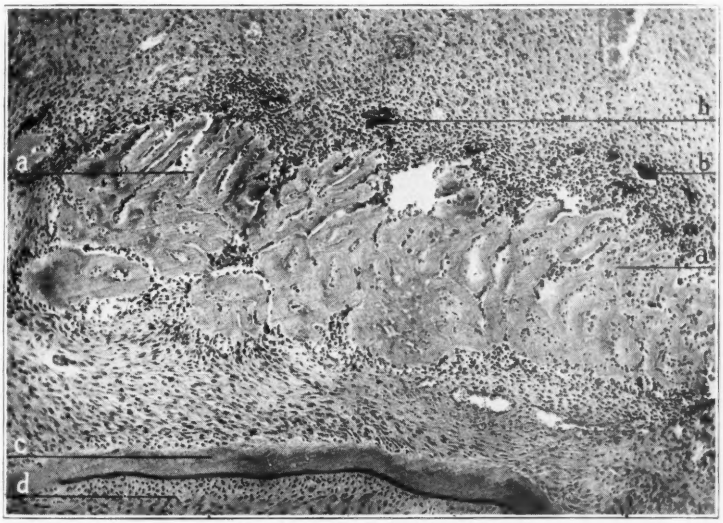

Fig. 12.—Large free denticle or pulp stone at *a* in the central portion of the pulp; epithelial rests at *b* near the denticle; *c*, lingual dentin; *d*, periodontal membrane. Notice the difference between this structure and the structure of the bonelike substance shown in Figure 10.

7. Höjer, A. and Westin, G.: Scurvy of the Jaw and Teeth in the Guinea Pig, Vierteljahrsschr. f. Zahnheilk., 1924, Nos. 2-3, p. 247.

8. Fridrichovsky, J.: Histology of Denticles, Ztschr. f. Stomatol., 1927, No. 2.

secondary dentin has been described by Orban:[9]

"The presence of epithelium is necessary to sensitize the pulp tissue in order that it may differentiate into odontoblasts. Brunn first called attention to the fact that no dentin can be built without the presence of epithelium. . . . This is not only true for the normal dentin development, but also for the development of denticles and sometimes for secondary dentin." Therefore, the presence of great numbers of epithelial cells shown in Figures 12 and 13 would seem to indicate that they had a definite relation to the development of this large denticle. The development of this denticle has especial significance in this case. Dentin can be built only by pulp tissue and not by common connective tissue. In Figures 3, 7, 8, 9 and 10, the development of bonelike substance from common connective tissue can be seen in the center of the pulp chamber. Near the apex, the building of dentin was in progress within fairly normal pulp surroundings. This difference between the apical pulp tissue and the tissue higher up in the pulp chamber shows that the changes from pulp tissue into common connective tissue gradually took place.

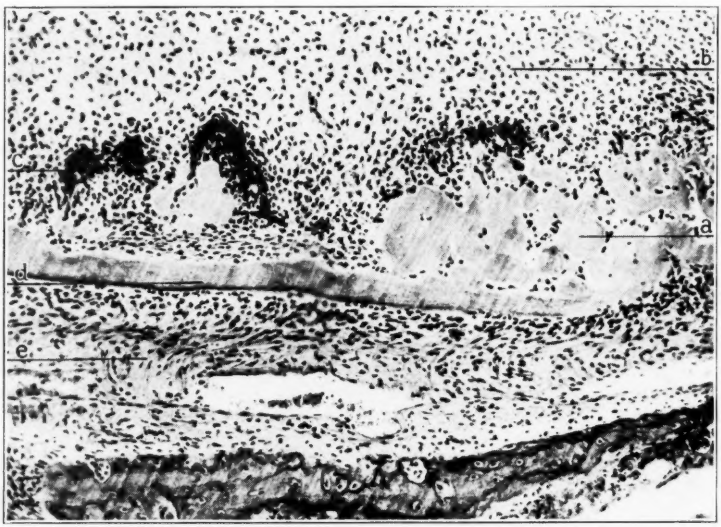

Fig. 13—Denticle or pulp stone *a* attached to the wall of dentin; *b*, pulp; *c*, epithelial rests in the pulp; *d*, lingual dentin; *e*, periodontal membrane.

In the apical region, the epithelial sheath of Hertwig is seen, which is an indication of continuous growth of the tooth.

Figure 14 shows the lingual surface of the tooth at the apex. Hertwig's sheath can be clearly seen. Outside of this is

9. Orban, Balint: Epithelial Rests in the Teeth and Their Supporting Tissues, Proc. Fifth Annual Meeting American Association Dental Schools, 1928, p. 121.

periodontal tissue and inside pulp tissue. A narrow strip of dentin appears to be in the process of formation by the odontoblasts which line its inner border. Higher up in the pulp chamber, as seen in Figure 7, the odontoblasts are missing; this case, dentin is built only in the extreme apical region as, higher up in the pulp, the odontoblasts disappear. The labial wall of dentin shows the presence of odontoblasts much higher in the pulp than does the lingual wall. Hence, the

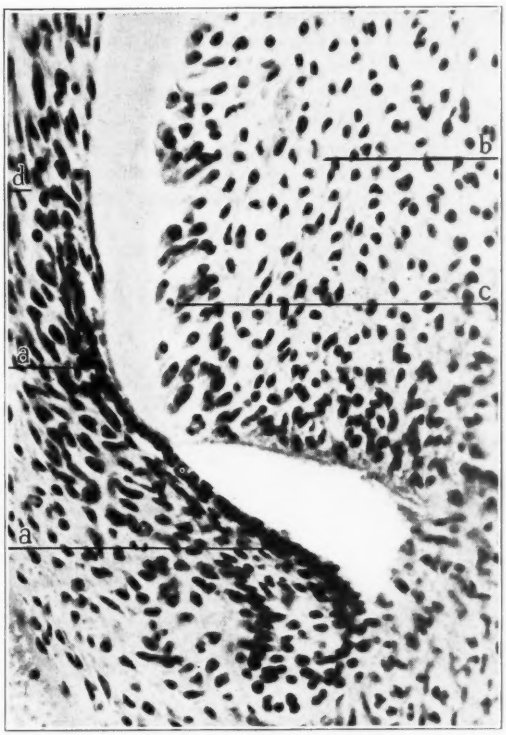

Fig. 14.—Hertwig's epithelial sheath *a* at the lingual wall of the central end of the tooth; *b*, pulp; *c*, odontoblasts building dentin; *d*, periodontal membrane. The space above *a* is due to shrinkage in the specimen.

which accounts for the abnormally thin lingual wall of dentin, as described in Figure 1. Dentin building progresses normally in the whole pulp and leads to a continuous thickening of the dentin toward the cutting edge, where the pulp becomes obliterated by this process. In labial wall of dentin is considerably thicker than the lingual.

SUMMARY

In our attempt to interpret the significance of the presence of unusual bone-like substance in this pulp, a detailed

study has been made of each section of the tooth to obtain the normal or abnormal characteristics of each part and see how they may be related. We have seen practically normal pulp tissue up to the middle third, where the character of the pulp tissue changes, and a fibrous tissue with partly hyaline degeneration and ossification appears. The incisal third, which is normally obliterated with dentin, shows different stages of necrosis. In the middle portion, where hyaline degeneration and ossification took place, the pulp cells seem more like common connective tissue cells and they are comparatively few in number, while the intercellular substance occupies most of the space. Under certain conditions, connective tissue cells become odontoblasts; and under other conditions, they may become osteoblasts. In embryonic tissue, undifferentiated cells may build bone, muscle, membranes, endothelium or red and white blood cells, according to Klaus von Dettrick.[10] In ready connective tissue, certain functional or chemical influences seem to develop unusual osteoblastic power in cells where, normally, they would not possess such power. If such changes in function take place in cells of the connective tissue in the skin, muscle or other places where they produce metaplastic osseous substance, it would seem that a condition of similar description found within pulp tissue might also be termed metaplasia.

In the terms of general pathology (M. Borst), we would classify this case under indirect regressive metaplasia, regressive or otherwise anaplastic because a tissue differentiated for a higher function (building a dentin) has changed to a lower function of building bone. However, the special characteristics of pulp tissue introduce difficulties in determining the nature of these changes. The pulp has characteristics of an embryonic tissue, and therefore it is difficult to determine whether the changes which took place before bone formation are regressive or progressive, but in comparison with the building of dentin, we may call them regressive.

In presenting this case, which has merely a theoretical significance, we offer it as a contribution to the study of the biology of the pulp.

10. Dettrick, Klaus von: Virchow's Arch. f. Path. Anat., 260:436, 1926.

INTERPRETATION OF THE ROENTGEN-RAY FILM AS THE BASIS OF MODERN DENTAL PRACTICE*

By ROSCOE L. STOUT, D.D.S., Chicago, Ill.

THE present-day practice of dentistry consists of the application of many varied operations and methods of technic or procedure, together with the aid of a few well chosen drugs in relieving, repairing or restoring the teeth of the human family and thereby conserving and improving human health as we find it. Today as never before, it involves the application of all our knowledge and methods in the prevention of the many dental ills, and systemic disturbances following, that we human beings have suffered from in the past.

No surgeon, general or dental, is to

*A lecture-demonstration before the Section on Radiology at the Midwinter Meeting of the Chicago Dental Society, Jan. 14, 1929.

be censured if an operation fails, provided his diagnosis is correct and his operation has been carried out according to the accepted methods of procedure. The first consideration in every case is a correct diagnosis; and to that end, every possible means of investigation should be employed.

In making a diagnosis of dental disturbances, the roentgen ray becomes an aid of first importance, and it should be employed in every case before any operations are contemplated, except in emergency cases when something must be done to relieve severe acute pain.

To fail to secure a roentgen-ray survey of the teeth and jaws of every patient is for the dentist to rob himself of a most valuable protection as well as an opportunity to render a service that is far more beneficial to the patient and, in most cases, more remunerative to himself. To fail to secure such a survey is to deny the patient something that he is rightfully entitled to in the light of present-day knowledge and, because of the trust that the patient places in the dentist, is to fail to fulfil a moral obligation.

If only a given tooth is under consideration, the requirements of the case are not being met unless a complete roentgen-ray survey is made for the patient. If only a simple cavity is under immediate consideration, there may be other teeth with caries almost as extensive or in a necrotic condition that may easily be overlooked even by careful methods of examination; conditions which may completely change the outline of operative procedure.

The question of the value of a tooth has come up in court many times, and the extraction of the wrong tooth has been the cause of many damage suits and sometimes of malpractice suits. To my knowledge, no suit for malpractice has ever been brought against a dentist for failure to discover caries in its incipiency; but such a thing is very possible in cases in which a complete roentgen-ray survey is not made, for this is now our most efficient means of locating caries before it progresses to such a stage that it is self evident to the patient, if not the dentist, and gross damage has resulted to such a tooth.

Howard Raper,[1] in his latest book, tells of a case that demonstrates how completely caries in early stages can be overlooked by careful practitioners. A young lady with seven carious areas, as demonstrated by a complete roentgen-ray survey, was sent to ten reputable dentists for mouth examination. Two of the ten were notified that there were in that mouth seven carious areas. Not one of the ten dentists found all of the areas, and so the examination was a 100 per cent failure in their hands.

Try this in your own practice. The more times you try it, the more importance you will place in the full roentgen-ray survey as a routine in practice.

Some one recently wrote into the question and answer department of one of our trade journals and asked for a sales talk that would convince his patients that they needed roentgen-ray examinations of the teeth. The answer was that he would first have to be completely sold to the idea himself, and then it would be easy to sell the idea to the patient.

It is hard to conceive what arguments some dentists can put to themselves for not making a full roentgen-ray survey of the teeth and jaws for every patient as regular routine practice. So many are still guessing. So many are still waiting for cavities to get big, for abscesses to become acute or, if chronic, to bring

1. Raper, H. R.: Clinical Preventive Dentistry, 1926.

about conditions that incapacitate the patient. Then they begin to try to find out just how bad conditions really are. Even today, after all our talk and work along lines of prevention, many dentists appear to be content to wait for trouble to trouble them or their patients, or, it would appear, would much prefer to have the patients themselves or, worse still, their physician secure a complete roentgen-ray survey. Some dentists apparently try to save their patients the expense; but it becomes more and more apparent every day that those in poorer circumstances need this service most because the rich can employ expensive ways and means of restoring their failing health. They can seek the service of eminent physicians and surgeons; they can take time to go to expensive health resorts and sanitariums or take extended expensive vacations in warmer climates or at the seashore. Those less fortunate must stick to the job and carry on though suffering from an impaired physical condition which might have been prevented by an earlier roentgen-ray survey of their teeth and jaws. Those people, besides having the health problem, have an economic problem, and to them a roentgen-ray survey that demonstrates pathologic conditions is perhaps the best expenditure of their money.

The roentgen ray is a means of making an examination in pathologic conditions. Usually, pathologic examinations are made at postmortem.

By the roentgen ray, we can detect disease; we can study it, if we wish to; we can watch it develop and grow. After we detect it, we can eradicate it and then observe repair and restoration to a healthy state. In the roentgen ray, we have one of the greatest factors in prevention of dental disease.

There is no good reason for not employing the roentgen ray in every dental operation. When a complete survey is made before restorative operations are attempted, it becomes the basis for determining the possibilities that a given case presents. For the dentist, it is an aid to various operative and restorative procedures. It is an opportunity and a convincing argument in rendering to the patient a service that is more healthful to that patient and, at the same time, a more remunerative service for the dentist. It is the foundation for better health service and for greater financial returns from that service.

The findings demonstrated by a complete survey need not always be completely rectified immediately, but the dentist is given an opportunity to demonstrate to patients the conditions existing and to tell them the truth about their teeth and jaws and their general health.

It gives the patient an opportunity to study his own case and think about how he wishes to proceed and how much he cares to spend in handling the conditions demonstrated by the roentgen-ray survey. He may be compelled by financial circumstances to proceed with the work by degrees. Such a patient may make an ideal person for the dentist to have on his emergency call list as one who may be called in to take care of legitimate broken appointments. He may make an ideal patient for the dentist to call in for the making of a certain restoration at certain times of the year when business becomes a little quiet. Such a service may be rendered in some cases at a discount and yet materially benefit the patient and dentist.

A complete roentgen-ray survey of a new patient must of necessity compel the dentist to render the highest possible service at his command.

A complete roentgen-ray survey opens up a perfectly logical opportunity for the dentist to ask the patient how much he cares to spend on the care of his mouth. There is no use trying to sell a man a Packard car when his financial condition makes it absolutely certain that he can buy only a Ford car. Yet many a man, perhaps some of you, has started out intending to buy a Ford but after a little shopping around and after a few demonstrations has purchased something costing three times as much. Many times the patient comes to get an amalgam filling repaired. A complete roentgen-ray survey reveals astonishing conditions. A truthful health talk and some demonstrations by illustrative cases result in the patient's buying a $200 or $300 cast removable case.

There is no good reason for not employing a complete roentgen-ray survey in every case in practice. Such a procedure is a protection to the patient. It is an aid to the dentist in making a diagnosis and in outlining operative and restorative procedures; and when employed at the conclusion of completed cases, serves as an excellent record and as a protection to the dentist from unjust or unreasonable comebacks. It might become the best possible evidence in case of claims that may reach the courts. It is the fingerprint of dentistry.

The public in general believe in roentgen rays. Many people place too much confidence and faith in them. It is to the shame of present-day dentistry that roentgen-ray examination is many times first suggested, in some cases demanded, by the patient and, in so many cases, demanded by the physician.

No dentist can successfully convince his patients of the necessity of a complete periodical roentgen-ray survey unless he himself believes in the necessity for such a survey.

Such a survey is never a diagnosis. It only serves to reveal the density of the jaws and teeth, and from it conclusions may be drawn, procedures determined on and a prognosis made. In cases in which impairment of the general health is evident, the consultation and advice of a competent internist should always be sought, and, in some cases, his advice should be followed even when such procedure may not be entirely clear to the dentist.

It is to this end that I give my feeble effort in presenting this subject, to convert you to a more complete use of the roentgen ray as daily routine practice, that you may render a better health service to your patients, and that they may have a better understanding of the possibilities and limitations of dental service and be awakened to the necessity of a more conscientious cooperation on their part.

The earliest evidence of dental disease can be demonstrated on the roentgen-ray film, beginning caries and peridental tissue destruction; also the progress of these two early evidences of dental disease, the carious condition progressing to pulp involvement and apical changes in peridental tissues, and those simple changes progressing to alveolar bone disintegration, resulting in the formation of the small granuloma, increasing to enormous size and becoming cystic in appearance and size.

The roentgen-ray film demonstrates conditions at the root end of diseased teeth where no definite encasement membrane develops but a disintegration of bone cells takes place known as liquefying osteitis; or its opposite, an extra deposit of lime salts, known as condensing osteitis.

The roentgen-ray film reveals the progress and end-results of degenerative processes of the investing tissues and conditions of the alveolar ridge which make the rendering of efficient denture service almost impossible in extreme cases. Large cysts of abnormal teeth, supernumerary teeth and various teeth impacted or embodied within the jaw bones are also revealed.

The only hope for a bigger, broader more health-giving dentistry is to be found in a more concerted effort in teaching and practicing real preventive dentistry.

When disease is demonstrated by the roentgen ray, it becomes imperative on the dentist to correct it or eliminate it. Complete elimination of a diseased condition can only follow in many cases by employing modern surgical procedures.

To extract a tooth in lieu of rendering it pulpless is to practice preventive medicine and surgery. The pulpless tooth problem is before us today as never before. Our past efforts at devitalization have, on the average, been mostly failures, as shown by the roentgen-ray surveys of many thousand cases that have passed through my hands. There are some apparent successes. There are some operators that will show a higher percentage of apparent successes than the average.

The reaction to a disturbing factor is a very uncertain thing. Take two individuals and inject an average dose of typhoid vaccine and note the results. One has a slight reaction; the other, a violent reaction. One individual suffers in a cold climate, another suffers in a hot climate. Infected teeth may kill one individual, while another will resist infection entirely. Therefore, teeth must be considered less as teeth and more as a part of a living human being. The presence of an infected tooth may be safe for one, and may mean a fearful risk for another.

No living man can classify pulpless teeth as to their effect on the health and life of an individual. The roentgen-ray film does not answer the question. It is only a study of the dentistry of the teeth and jaws and never affords a diagnosis.

The overload any individual can carry is too serious a problem to be considered lightly. The amount of overload any given individual is carrying is something that we cannot definitely determine. When an individual breaks under any overload, whatever it be, the damage done may be too serious to be overcome by any combination of therapeutic measures.

Heart valves, kidneys and joints are tissues that cannot be relieved or restored to normal by operative procedures. The elimination of an infection of long standing may prevent further pathologic changes, but usually certain damage has been done that renders that tissue less than 100 per cent efficient throughout that life.

Death from heart disease ranks first of all diseases today. It may be found that dentistry is responsible for this. Our desire to save teeth that may later become infected may be found to be the principal cause for our present high death rate from heart disease.

Infection is the agent that most seriously affects the highly specialized tissues of the body. To prevent every possible infectious process is to build a healthier individual, and this tends toward a longer, a more comfortable and a more enjoyable life.

Measles, scarlet fever and diphtheria are infectious diseases, and many individuals who are unfortunate enough to contract any one of these may suffer to some extent therefrom throughout life.

Society at large is protected by law from these diseases. The individual having scarlet fever is placed under quarantine as a protection to the life and health of others as an economic measure for the community.

The extraction of a tooth in lieu of rendering it pulpless, with its possible chance of later infection causing distant or systemic disturbances, may be just as much of a health measure or economic question as the quarantine.

From the results observed by examination of thousands of roentgen-ray films of teeth and jaws, I can see little good in the attempted practice of retaining so-called treated teeth. I am not, what has been called a 100 per cent vital tooth advocate. There are many, many people today carrying pulpless teeth. As we cannot classify those teeth as to the effect on the health and life of the individual, it follows that many of these people must carry on and handle their individual case as time goes on and as we gain in knowledge on the subject.

Were I in general practice today, I would retain some pulpless teeth when not to do so would be to deny that individual the comfort and usefulness of a large restoration that could not otherwise be constructed or an anterior tooth difficult to replace.

Many heart breaking cases will come to our hands and the solution of each case demands that we use every possible means of examination and investigation at our command; namely, a complete roentgen-ray survey, a careful mouth examination, study models and, in complicated and serious cases, the cooperation of a competent medical man and all his means of a complete physical examination, together with a history of past health and the hereditary possibilities of the case.

I agree, and most of you agree, with Raper[1] in his statement that the only satisfactory solution of the pulpless tooth problem is the prevention of the pulpless tooth. This, of course, is a matter of education of the masses, and to this end dentistry must preach, teach and practice mouth hygiene and prophylactic measures to the degree that no pulps will ever become endangered. This is not utopian. It may not come in our life time, but this must apparently be the ultimate solution of the problem.

A more intensive application of the roentgen ray as a routine measure in mouth examination will save many, many teeth; for by it small areas of decay will be discovered and such teeth can be filled before the pulps are endangered.

We cannot, it appears, prevent caries, except in a few selected and well managed cases in which intensive prophylactic treatment is instituted, but we can prevent caries from progressing to such a stage that the pulp, the life of the tooth, need never be sacrificed. The roentgen ray is our most effective means of discovering caries in its early stage, and to fail to use it in every case is to lay ourselves liable to criticism.

STREPTOCOCCI AS I KNOW THEM*

By U. GARFIELD RICKERT, A.M., D.D.S., F.A.C.D., Ann Arbor, Mich.

STREPTOCOCCI have been so generally accepted as the principal etiologic factor in the suspected secondary effects of the presence of infected teeth that I have decided, after being assigned to the bacteriologic aspect of this symposium, to speak to you on the subject, "Streptococci as I Know Them." There is an admitted strategy in the carefully worded title which permits me to engage in the somewhat dangerous practice, from the scientific standpoint, of drawing conclusions from observations, which future scientific advances may prove inadequate, and still speak truthfully. I have been studying and observing for seventeen years the several conditions in which this little demon of the night seems to be playing a major part. It is of these observations that I shall speak.

I struck this planet in a small northern Ohio town, which was the home of the largest bee supply industry in the world. As a boy, I was fascinated with the nerve and daring of the beekeepers. At the county fairs, they would sit all day in large glass and screened cages where thousands of bees were busily engaged in making honey from the flowers and syrup placed in the enclosure. I marvelled at the beekeepers' technic in brushing aside those that lit on the face or bare arms. They did it with about the same indifference that you or I would brush aside a trespassing house fly. I was sure that if the brushing were to be done by me, I should be stung; but not so with the beekeeper, for he knew the brushing technic. Now as I look backward with the newer perspective, I am conscious of the fact that I too was confined in an environmental enclosure with little death dealing imps, far more treacherous than the busy little bee. The wonder of it is that, during all these years, you and I have been unconsciously brushing aside these little demons of the night. It is true that at times, during attacks of scarlet fever, measles, and other diseases, we have felt the streptococcic sting because we have not as yet either consciously or, by natural selection, unconsciously learned in detail the brushing technic of the beekeepers. If we as a profession are to cope most successfully with this mysterious organism, a better understanding of its subtle characteristics is a most urgent necessity.

Streptococci are with us from the cradle to the grave. We cannot escape them. Several years ago, I was associated with a group of bacteriologists interested in devising methods for increasing the virulence of avirulent streptococci. Some of us had obtained the idea from the literature that the organisms rapidly increased in virulence in the mouths of very young infants. We decided that if

*Read at the Midwinter Clinic of the Chicago Dental Society, Jan. 16, 1929.

*The papers of Drs. Rickert, Blayney and Miner were presented as a symposium on "The Problem of the Pulpless Tooth."

this were true, some light might be available as to why such change took place. I went to the maternity ward and cultured the mouths of a number of babies, ranging from 2 to 14 days old. Quite contrary to the impression acquired from the literature, not one of these cultures proved virulent to the most susceptible of laboratory animals. It is of interest that the mouths of these infants were already inhabited with millions of streptococci. These babies were successfully meeting the offensive by an inherited defense and an acquired brushing technic as the result of natural selection, and the general hygiene of the ward. Turning from the early period of the span of life to the final end, permit me to quote from memory, as nearly as possible, a statement which Dr. Mayo gave to the Medical and Dental Faculties of the University of Michigan about fifteen years ago. He said, in substance, that it matters not whether the patient dies from diabetes or nephritis, tuberculosis or cancer, one can be assured that, in the majority of these cases, streptococci strike the last fatal blow. He illustrated his argument in the case of cancer by saying that this rapidly growing neoplasm continues until finally the circulation is no longer able to keep up with it. Then, the defensive mechanism breaks down, and the tissues become infected with streptococci, which permits the absorption of both the infective and toxic substances to complete their work.

About fifteen years ago, as a graduate student of bacteriology in the Medical Department of the University of Michigan, I received my first disturbing fears of certain strains of the streptococcic group. There were "whispering campaigns" among the students to the effect that studying in the medical school was indeed a hazardous occupation. Further, it was whispered that somewhere in the hospital there was some source of infection, then spoken of as a short chain streptococcic throat infection. In fact, practically all of the students with this infection, which had reached epidemic proportions, were medical students. The infection ran a typical course. The patients with marked arthritic diatheses began with sore throats, later developing acute inflammatory rheumatism of varying degrees of severity, which, in a considerable percentage of cases, finally terminated with serious heart involvement. During the acute rheumatic stage, it was usually possible to obtain cultures of the organism from the blood, which proved to be rather short chain hemolytic streptococci. The course of the disease in the less susceptible was much milder, and the severer symptoms never appeared. Even by graduate students in the department of bacteriology, the dreaded organism was most cautiously studied.

It was at this time that I became city bacteriologist of Ann Arbor, and I had the good fortune of cooperating with the health service of the university in actually tracing the origin of this epidemic. It was found that practically all of the patients, largely medical students, had been patrons of a certain boarding house, and finally that this boarding house used the entire supply of a large dairy, the milk not being pasteurized. From the employes of this dairy, it was learned that there had been a cow in the herd with a diseased udder (mastitis), the condition later proving to be a streptococcic infection. The milkers themselves had been affected with the throat infection. The milk from this cow was discarded, and the owner was compelled to pasteurize the milk that he sold. The epidemic as such has had no recurrence during the past fifteen years. Both Chi-

cago and Boston have experienced similar epidemics, also traced to the milk supply.

Five years later, when I began the study of the types of infection prevalent in suspected teeth, I was astonished to find the general prevalence of a morphologically identical streptococcus, later determined to be culturally different and belonging to the viridans group, a green-producing nonhemolytic strain. Even with these different cultural characteristics, this mysterious and frequently virulent strain of organism was cautiously studied. By this time, we had had sufficient experience to appreciate the dangerous character of certain strains of the streptococcic group, and for a time, I, too, approximated the hundred per cent vitalist. Some of our associate workers had brought to us rather definite evidence of mutations of the strains. Not only was there evidence that the nonvirulent type might be changed to the highly virulent, but one of my co-workers, R. W. Pryor, now with the Board of Health Laboratories of the State of Michigan, found that he could take the organism, isolated from the blood of scarlet fever patient, through a cycle of changes, producing four distinct morphologic variants, and finally recover the original organism. In one stage of this cycle, the organism had the morphologic appearance of some of the diphtheroid groups. This was of especial interest to me since, at the time, the work of the Dicks had not as yet so closely proved the etiologic relation of streptococci to scarlet fever, and I had frequently observed diphtheroid organisms in the throat swabs of patients suspected of diphtheria which later proved to be scarlet fever. We believe that the significance of streptococci in the course of scarlet fever is still incomplete.

I cannot resist reporting here the results of an experiment that we have never reported because time has not permitted us to complete the work. It was after I had demonstrated in our laboratories the permeability of the enamel of teeth when set up as membranes that E. C. Rosenow suggested that I find out whether streptococci are capable of growing through unfractured sections of enamel. While the enamel permitted the passage of water and certain ionized salts in nearly every case, it did occlude the growth of streptococci through its structure. We then tried unglazed porcelain membranes with slightly larger interstitial spaces as determined by osmotic pressures, and in these, the organism did after periods of days, grow through and appear in the medium on the opposite side of the membrane. These cocci were very small, producing only slight cloudiness on ordinary culture mediums, and were lost in our attempt to carry them on in other mediums. The possibility that part of the life cycle is ultramicroscopic would be a most interesting lead for further study. We should have liked to continue this side study, but it was impossible for the time because it was carrying us too far astray from our immediate program of investigation. The pleomorphic characteristics are mentioned that you may be in a better position to appreciate the reason for the confusion of opinions as to the rôle of this organism in infectious diseases and the lack of incomplete knowledge of the organism as compared to those whose specificity has been more accurately determined.

EVIDENCES OF INTOXICATION

For several years after graduating from the literary college, I held a position as an athletic coach. An incident took place during this time which aroused my curiosity to the extent that it was one of the principal reasons why I went back

to the university for further study in the field of bacteriology. Early in the basketball season, I observed that the abrasions due to violent contact with the practice floor produced vicious infections in practically every one of the players. The training floor had been for many years a general assembly room; but, with a new building available, the old assembly room had been turned into a basketball practice floor. From my elementary of knowledge of bacteriology, I decided that there must be some highly virulent germ in this room which would have to be destroyed before any relief from these infections would be possible. We secured a large amount of phenol, and the players scrubbed every square inch of the floor and the side walls as high as they could reach with a strong solution of this disinfectant. We spread a sufficient amount on the floor with brushes and left it there to dry in order that it might have sufficient time to act. We worked our way to the door, and finally, as a parting shot to our enemies, we placed a large charge of formaldehyd in the room, which was then closed for two days. I insisted that all the basketball togs be freshly laundered and that the players enter the room in a most hygienic condition, but the infections from abrasions on the floor still continued. Similar contact with the floor of the recently built auditorium, where the actual games were played, did not produce these infections. We finally abandoned the original practice floor. Now, with the further study of those conditions, it is clear to me that, in some way, certain toxic filth had been ground into that floor during the years it was used as an assembly room, and this toxicity involved the defensive mechanism of the injured vital issue to the extent that the ever present cocci had a most favorable field in which to become viciously active.

Recently, while traveling through your city, I observed with interest an announcement from the athletic section of one of your daily papers to the effect that the Illinois Boxing Commission had decided to permit the use of white boxing gloves because it had been observed that the dyes of the gloves now used carry infections sufficiently serious to incapacitate too frequently the principals of important bouts. Of course, you and I will understand that it was not the dye that infected the injured boxer, but that the dye or some other substance in the glove carried the toxicity that interfered with the defensive mechanism of the vital tissues adjacent to the abrasion, making possible a severe localized infection by the ever present cocci.

I have gone somewhat into detail with these experiences because they are intended to give you a better understanding of some of the initial changes that make the field susceptible to infection. Periapical infections are no exception to this rule. I am extremely zealous that the dental profession keep interested in developments in the fundamental sciences as they are related to technical procedures and daily practice.

We might consider at this time what is essential to the prevention of infection following root surgery and the evidence that will support this contention. First, we want to pay tribute to those early observers in our profession who recognized the importance of complete filling of pulp canals by adequate methods. Without the roentgen ray, and with a limited knowledge of bacteriology, it is greatly to their credit that this fundamental requirement was so early recognized from clinical observation only. The new conception that I wish to leave

with this audience is that we have been thinking too much as a profession of the significance of organisms in the process of infection without any regard whatever for the active part taken by toxic substances. Referring to the pulpless tooth: When a pulp has been removed from the immediate pulp chamber and canal, without injury to the periapical tissues, and such a pulp chamber is filled with an adequate filling material so that there is an inhibition of diffusion through the more permeable apical end, we have proved that such normally functioning teeth subsequently seldom become infected.

Diffusion from the circulatory elements of the periapical region invites infection because such elements, when removed from the vitalizing channels, may become toxic by stasis, even in the absence of infection as a result of toxic split protein products, as demonstrated by Novy and De Kruif.[1] This diffusion of foreign toxic substances from the critical end of the pulpless tooth usually precedes infection. The organisms then become an incident in the involvement. The patients who can build up a defensive quarantine (granulomas) are, as a rule, less inconvenienced by such intoxication or subsequent localized infections following intoxication. Patients may, in this way, be protected for long periods of time. The toxic substances have been changed by this defensive mechanism before admission into the general circulation. Patients who cannot build up this defensive mechanism against the diffusion of toxic material into the periapical region are more susceptible to localized infections and subsequent metastatic invasions.

In support of this view during our earlier studies, we observed that acute abscesses do not follow vital pulp extirpation immediately, even with the most flagrant violation of bacteriologic technic, unless the vital tissue beyond the tooth has been so extremely traumatized that it no longer retains any of its normal defense. Even then, as demonstrated later, acute infections seldom take place immediately. We observed that, after such operations by careless operators, the organisms of the saliva of the patient, even if sealed in, did not produce an immediate acute alveolar abscess in the absence of germicides. I was present at the Mayo clinic at Rochester, Minn., when one of the early classic experiments by Dr. Meisser on the teeth of dogs was undertaken. Vital pulps were removed, and even with the large number of organisms from infected teeth which were sealed into these pulp chambers, there were no immediate exacerbations. As a sequence to these experiments, I was quite interested in a recent article by Dr. Mayo,[2] in which he made the statement that it takes from two to five months for evidence of roentgenographic changes to develop after even such drastic procedures as the sealing in of organisms taken from infected teeth. By the time these changes have become evident, roentgenographically, inoculation with active organisms may produce immediate acute infection because the defensive mechanism in the apical region has been disturbed. For instance, the question has frequently been raised, in cases in which roentgenographic observations prove that the root filling is inadequate, although the tooth has given the patient no trouble, and coronal restoration is demanded, as to

1. Novy, F. G., and DeKruif, Paul: Anaphylatoxin and Anaphylaxis, J. Infect. Dis., May-June, 1917.

2. Mayo, C. H.: Interdependence of Medicine and Dentistry, J. A. D. A., 15:2011 (Nov.), 1928.

whether it is advisable, before undertaking coronal restoration, to replace such a root filling with an adequate one. My answer has always been in the affirmative. However, dentists have told me frequently that they do not like to disturb such teeth since, in their efforts to improve conditions, they often initiate acute abscesses. Before we had the more complete appreciation of actual conditions of the apical and periapical tissues in such teeth, we had similar experiences. This point is mentioned here because it indicates how easily infection will take place when the field has been prepared by the diffusion, covering many months, of toxic or split protein products. Under these conditions, a temporary equilibrium of tolerance has been reached on the border line between dead and still vital tissue. The least added insult from the involved side to the vital tissue may frequently be sufficient to set up an acute infection from a latent chronic intoxication and infection.

Cultural studies made in conjunction with roentgen-ray evidence show two possible types of periapical changes, due to intoxication in the absence of infection. One is that of the proteolytic change, previously mentioned, in which pulps have been removed with a certainty that there has been no instrumentation beyond the root end. These pulpless teeth have been culturally controlled and prove that, even in the absence of infection, roentgenographic changes do take place, in from two to eight months. In fact, it will be noted that this period coincides quite well (probably a little more time is required) with the time that Dr. Mayo designates as required for roentgenographic changes in dogs with the purposely inoculated pulp chambers. Sufficient work has been done in our own laboratory and clinic to verify this statement. In the second instance, we have those changes that may take place in the absence of infection much earlier than in from three to five months, which are the result of chemical and instrumental trauma. To illustrate: Recently, a patient came in with twenty-four gold shell crowned teeth. He said that his dentist (a quack) had assured him that if the pulps of several teeth were removed and the roots filled and crowns placed on all the teeth, his dental ills and expense would be forever ended. The fee quoted was $175. What is of interest here is that, within ten months after this work was completed, the patient experienced his first attack of arthritis. When we observed the well defined areas at the apices of the teeth, we were convinced, of course, because of the arthritis rather than the roentgenographic evidence, that they must be infected, and might have an etiologic relationship to the arthritic condition. But the most painstaking cultural method and direct stain smears proved the teeth still negative. They had been filled with a well-known slowly diffusible antiseptic root filling which had not as yet spent itself but may have been one of the toxic factors in the extensive periapical change observed in the roentgenogram. Subsequently, extraction of these teeth was rewarded with almost immediate relief of the rheumatism. Those of us who have had a number of similar experiences suspect that the toxic substances, split proteins, that may develop within an inadequately filled pulpless tooth may be of no small concern in the initiation of rheumatism as a result of protein sensitization. It is therefore evident that degenerative changes due to intoxication frequently precede actual infection of the involved parts. That powerful drugs do this rapidly has been many times observed in our clinical experience.

You may wonder whether these organic toxins derived in the absence of infection have ever been isolated and demonstrated chemically, serologically or immunologically. So far, we have been unable to distinctly demonstrate clear cut toxins by these measures, because, as you will observe, one seldom extracts teeth that are sterile. If we did, in these few cases, the amount of material that would remain after filtration would be very small, and it is of necessity so diluted that even the skin tests have not been sufficiently distinct to be accepted as final. In the presence of organisms, of course, this becomes much easier. A sufficient number of teeth may be accumulated, making possible the experiment. To date, then, it is admitted that the most substantial evidence that we have is that which is described above, and which is a combination of clinical and laboratory experience. The complete proof of this must soon be established.

If there is still so much confusion as to fundamentals, among the experimental workers, what, for the time, can the individual members of our profession do as their part in faithfully discharging their duties to the patients? We manage this problem at the present time by two entirely different procedures. In the first place, we recognize with our present knowledge, that there are certain patients in whom the elimination of all pulp involved teeth is advisable. These extreme cases will be discussed later in this paper. Secondly, many of our patients, from all the evidence thus far presented, are given better service, when certain fundamental requirements may be met, by surgical procedure less destructive than extraction. In all cases of pulp involvement, if the tooth can be dispensed with without serious inconvenience and loss of function to the patient, and a restoration will not be required for the lost member, extraction is justifiable. But if the patient demands a restoration and extensive cutting of the supporting teeth is necessitated, we have proved beyond doubt that, in many such cases, the interest of the patient is best served, even from the health standpoint, by measures less destructive, such as the pulp treatment of one tooth in preference to the involvement of two. For the pulp involvements that have too frequently followed the extensive preparations of the supporting teeth have just as definitely been proved to be initiating factors in certain secondary effects as have the pulpless teeth. That degenerating infected pulps have such etiologic relationship has been confirmed by many observers, among them Price and Rosenow.

There is nothing more disturbing than to have well-trained internists insist that the focus of infection must be found in the teeth, which are the dentist's field, when there are no pulpless teeth. The case becomes especially complicated when there are many large restorations, all responding to accepted vitality tests. We have recently had referred to us from our hospitals patients of whom the internists had made the most painstaking examinations and had insisted that the primary focus was somewhere about the head, outside their field, evidently a dental infection; although how these men can regionally locate the source of infection is still unknown to us. If there are one or two pulpless teeth, the dentist may extract them, but if there are extensive fillings, he cannot refer the patient back to the physician with the assurance that all dental infection has been eliminated. We shall not at this time cite cases, but we do admit that we have, under pressure from competent internists, removed and cultured vital pulps only to prove the

accuracy of his diagnosis. Those observers who are fortunate enough to be working in conjunction with experienced internists (not the ordinary general practitioner) can verify this statement just about as frequently as the definite etiologic relationship of the pulpless tooth can be verified.

We are convinced that if the profession most adequately discharges its duties to the public, it will solve this problem of pulp involvement by technical procedures less destructive than promiscuous extraction. If this method were universally adopted, there is no telling where extractions would end, short of extraction of all teeth involved with caries. It is true that preventive dentistry will, if ever effectively applied, noticeably lessen pulp involvement and more satisfactorily solve the problem; but we are treating many cases annually in our private practice and in our large clinic that could never have been avoided by preventive dentistry. In this age of strenuous athletics, beginning in the grade school and continuing through high school, college and university, we are constantly confronted with pulps involved as a result of trauma. Accidents due to our present-day mode of rapid conveyance add a large number to the list. Suitable restoration following extractions in many of these cases in our younger patients is at best extremely difficult, if not frequently impossible. The deferring of bridgework from five to fifteen years is certainly, in many cases which we have observed, postponing the time when the less satisfactory artificial denture becomes a necessity.

Following these observations, we were confronted with the problem as to whether root surgery technic could be developed which would inhibit diffusion to a point of tolerance by the adjacent periapical tissues, and yet not be too technical to be accepted by the general practitioner. The results of our experimental work in this field have been published a number of times and can be found in the literature, but a brief review will not be out of place at this time.

It became evident to us that a perfect sealing of the canal walls in the apical third, which is the critical end of the tooth, must be accomplished if the objectional diffusion was to be prevented. We at once experimented with a number of filling materials. It was obvious that the filling material should be adhesive so that the dental tubules along the walls of the canal would be so sealed by actual adhesion that diffusion would be impossible. The older filling methods failed to fill this requirement satisfactorily because the liquid portion in such materials as euchapercha and chloropercha, regardless of the care exercised in the condensation of the filling, did permit the temporary retention of the volatile material. This soon diffused out, leaving, it is admitted, but a small open space, yet one sufficiently large to be usually about the most ideal interstitial space in dimension for diffusion. Remember we are thinking in terms of diffusion, and a continuous interstitial space 0.5 μ in diameter has been the one determined in physical chemistry to be the most ideal dimension for the osmotic interchange of fluids in permeable membranes. The advantages that may have been derived from the chloroform-rosin treatment must have occurred as a result of inhibition of diffusion due to partial clogging of the tubules. The advantages that have been derived from the use of silver solutions are threefold: detoxication, sterilization and partial occlusion. The first mentioned is of the greatest importance. Proteins and split products are made

innocuous. The filling material that we are using at the present time had to stand the test in root-filled laboratory teeth before it became acceptable for our own established requirements.

The preparation that we are using at the present time, which is known as "root sealer" and was compounded according to our own formula, is so adhesive that the office assistants have frequently complained that it is difficult to remove it from the glass slabs upon which it is spatulated just previous to insertion. The containers in which the sealer is dispensed contain also a bottle of xylol to be used in cleaning these slabs. When such root-filled laboratory teeth have been subjected to our laboratory test, the capacity for diffusion has been reduced to a minimum, and the favorable results that we have had and those reported to us from many other operators can be attributed more to this property of the root-filling material than to any other single factor. It is true that this sealer is quite antiseptic during the five to ten hour setting period, which gives the advantage of caring for slight accidental breaks of asepsis in the technic, but after the mass is set, it is only slightly inhibitive in direct contact with the organism. This requirement is of great importance since it must be evident that no filling material can be permanently germicidal without being at least slightly soluble, thus eventually dissipating itself both as to antiseptic value and as to the required mass essential to a complete filling of the canal.

The satisfactory clinical result with this preparation, then, is one of the evidences of the importance of occluding diffusion. We are not offering this technical procedure as the last word on root surgery, but it is submitted for your approval and criticism. We invite you to tell us in what respects it fails to meet your requirements. While we are encouraged by the many letters from operators speaking of increased satisfaction with this method, we are not so solicitious for these compliments at the present time as we are for the constructive comments on what the operators believe are its limitations. Many dentists have told us that the operation has changed from a dreaded one to one that is really extremely interesting. For instance, they say, "We can hardly wait for the development of the roentgenogram to see what technical success we have really had. Personally, before we had this more operable procedure, the day was ruined when I looked over my date book and found two or three root canal patients. That is no longer the case. In fact, it has become one of the most interesting operations that I have to perform."

A bacteriologic discussion would be incomplete without at least a review of its application to diagnosis. We recognize the fact that a complete bacteriologic diagnosis such as we are able to make in our institutional clinics would be altogether too tedious for the general practitioner. At the present time, we are trying to standardize technical procedure and make it simpler, so that, in routine work at least, much of the apparatus required in experimental work can be dispensed with.

Dentists are constantly asking how long a suspected infected tooth must be treated before it is ready to be filled. While there are varying conditions and probably no set rule will ever be possible with less equipment than a microscope, the time when the canal is ready for filling may, in the average case, be determined reasonably well by certain signs, which will be given in our final report. Generally speaking, any case that cannot be satisfactorily managed in ten days is

one in which either resection or extraction is indicated. Perhaps the most encouraging announcement that can be made at this time is that culture medium and the necessary incubator can quite well be dispensed with and about the same information secured by the simple use of direct smears studied under the microscope. We hope that even this detail may later be rather safely eliminated.

Procedure other than taking a case history which we use in our own private practice and clinic to determine whether a tooth of strategic importance should be extracted or retained can best be given by citing several of the quite recent typical, yet somewhat extreme, cases in which this decision had to be made.

REPORT OF CASES

The case history was obtained from the physician. A woman, aged 54 whose chief complaint was migraine (severe headaches), had one pulpless molar and two single-rooted pulpless teeth. Roentgen-ray examination in our office revealed the fact that the single-rooted teeth appeared to be adequately filled. The root-canal contents were cultured at different levels by a method outlined elsewhere in the literature. (It will usually be found that no growths will develop until the apical third or quarter is approached.) The two single rooted teeth were not infected. Our examination revealed the fact that the patient had had extremely high blood pressure, which was not reported in the case history by the physician. While it was recognized that such blood pressures are frequently lowered tremendously by the extraction of large numbers of infected and toxic pulpless teeth, there was no reason to suspect that these teeth had anything to do with either the headaches or the high blood pressure. Extraction of the molar was recommended and the canals of the two cultured single-rooted teeth were carefully refilled.

As opposed to this, let us turn to another type of case. The patient came from a most competent internist, and presented the following history.

The history, taken five months before our examination, revealed a septic throat infection which developed into an acute rheumatic fever and finally an infective heart involvement. The patient had two pulpless upper bicuspids. Cultures were taken with the same technic as outlined in the previous case. A well-known, slowly diffusible root-filling material showed infection even in the upper part of the canals, and an extremely large number of streptococci were present in all of the canals. Moderate doses of these cultures killed the laboratory animals within twenty-four hours. With the case history, we of course, refused to treat the case even with the satisfactory methods that we use in all other cases. Extraction was recommended.

Neither dentist nor patient can expect phenomenal recoveries in this type of patient. Whether the teeth were the initiating factors in this case will never be known, but from a study of a large number of such cases, we doubt that they were more than a contributing cause.

Another interesting case recently examined is illustrative of our diagnostic measures. This was of interest to me because I did the root-filling in the three single rooted teeth. One had been filled eight years, one five years and one four, when the patient was referred back to me by the physician.

The patient, aged 30, had just passed through an acute attack of articular rheumatism which developed a few months after childbirth. The case history showed anemia. The attending physician, previous to the rheumatic attack had insisted on treating the anemic condition by ultra-violet light. Immediately after the seventh treatment, the patient experienced the rheumatic attack. After recovery, the question arose as to whether this attack was caused by the condition of the teeth, and the patient came to my clinic. I removed every one of the root fillings very carefully. The contents were all free from odor. We even aspirated the apical ends of the teeth, which from the standpoint of treatment was contra-indicated, because such insulted teeth will develop slight soreness. The cultures were all negative, and

certainly there was no reason for extraction on such evidence.

I am convinced that the light treatment in this case initiated the rheumatic attack. I have been observing this for some time. Even the excessive sunburns of the seashore or beaches frequently cause arthritic attacks of varying degrees of intensity. Dr. Holman, in his splendid review of the literature on arthritis, noted that a German investigator had made similar observations.

We shall cite just one more case of vital interest. The patient, a dentist, had six pulpless teeth which I had treated about seven years earlier. The physicians suspected peptic ulcer and turned his attention to the teeth. The roentgenographic evidence was negative, but in the serious condition, several of the more accessible root fillings were removed and cultured, all with negative results. The dentist said that he was satisfied, and no extractions were undertaken at the time. About a month later, he returned and said that he occasionally experienced in an upper molar with a large filling little brief twinges that could not be called painful. The pulp was tested and found to be vital, but because of slight pulp change, similar to that noticed in many other cases, and because of the extensive restoration, the tooth was extracted. The pulp was normal even in the horn of the pulp chamber on one side, but, on the other, immediately under the large amalgam restoration, the pulp had slightly receded and turned a dark gray, owing to diffusion from the large amalgam restoration, which was probably leaking. This pulp was cultured and streptococci were isolated. The first laboratory animal intravenously inoculated with the organism developed multiple pyemic abscesses of the gastric mucosa.

This does not prove that the tooth was the initiating factor. It only proves that, under the deranged circulation of the pulp, we succeeded in isolating an organism that probably may have entered the general circulation at a period of overflow from the original focus in the stomach of the patient. This tropic characteristic is not difficult to understand when we consider how sensitive many organisms are to the immediate chemical reaction. Here, we had an organism that could exist in a comparatively strong acid medium such as is present in the stomach. If it had any degree of virulence when inoculated into another animal, it is easy to understand that it could readily attack a tissue in an acid medium, such as it had become adapted to in the mucosa of the patient. You may call this elective location, or anything else that seems fitting. This laboratory curiosity is frequently easy to demonstrate in the case of gastric ulcer. This case is presented rather to show you how easily I might have, without laboratory facilities, condemned all the pulpless teeth and permitted the one to remain which, to say the least, was probably more concerned with the involvement than the six pulpless members were.

CONCLUSION

We must recognize that streptococcic organisms are ever with us; that we cannot by hysterical retreat escape them. During the Great Plague of London, a panic-stricken population took to flight, as though they could escape the epidemic in that way. This resulted in every highway leading from the city being strewn with the sick, dying and dead. Yet there were those who, in the terms of Captain Lawrence, said, "Don't give up the ship," and remained in the city. They took inventory of the situation, with the result that, later, a saner protective measure than flight was made possible, and the plagues have ceased. If we as a profession are to solve this problem sanely, we cannot afford to become involved in extraction hysteria, because such measures fail to lead us forward. If we are to make our contribution to science, we must meet the ever-present subtle streptococci on more than even terms and deal with them

in a manner similar to the intuitive brushing technic of the beekeeper.

Ten years ago, I was lead to believe that the most urgent and immediate problem before the profession was whether a surgical technic could be developed which would safely manage pulp involved teeth. We now know that if certain fundamental requirements are met, this operation ranks well with the success of any of the other more important operations. The question, then, is no longer Can it be done? It has changed to Do the dentists want to do it? It is you, not I, who must make this decision.

PRESENT CONCEPTION OF VITAL REACTIONS WHICH OCCUR WITHIN APICAL TISSUES AFTER PULP REMOVAL*

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THE object of this presentation is to convey to those in general practice our idea of the changes which usually take place after pulp removal. In order to keep within the time at our disposal and also for the purpose of avoiding confusion, I have chosen to confine this discussion to those changes which follow the removal of vital pulps under ideal conditions, leaving all other cases which demand treatment to future consideration. For the purpose of simplicity, many of the illustrations are schematic, or, I might say, a composite representing the views which have been developed during the study of a large number of microscopic specimens taken from many pulpless teeth whose clinical course and case histories were available at the time of histologic study.

During the past years, the relative values of a tooth containing a normal healthy pulp and one containing a root-canal filling have materially changed. I may say that, according to our present conception, a normal pulp is very seldom, if ever, removed. Even though this is the case, it is well to begin the illustrations by first considering the normal. We see in Figure 1 a longitudinal section of a lower single-rooted tooth containing a normal pulp with its surrounding bone. In the apical region, the pulp canal suddenly divides into several smaller channels. On close examination, the soft tissue within these small canals is found to be entirely free from odontoblasts and to resemble fibrous connective tissue which serves to conduct the vessels and nerve fibers to and from the pulp; all of which means that these smaller branches are not within the dentin but in the cementum.

The presence of these accessory canals insures an abundant collateral circulation, which is essential during the inflammatory and reparative changes which follow operative trauma. If we recognize that, in most cases, accessory foramina exist, and then direct our treatment so as to conserve this fibrous tissue, we find that such multiple openings have a definite physiologic value.

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*Read before the Midwinter Clinic of the Chicago Dental Society, Jan. 16, 1929.

Fig. 1.—Longitudinal section through lower anterior tooth and mandible, illustrating normal condition.

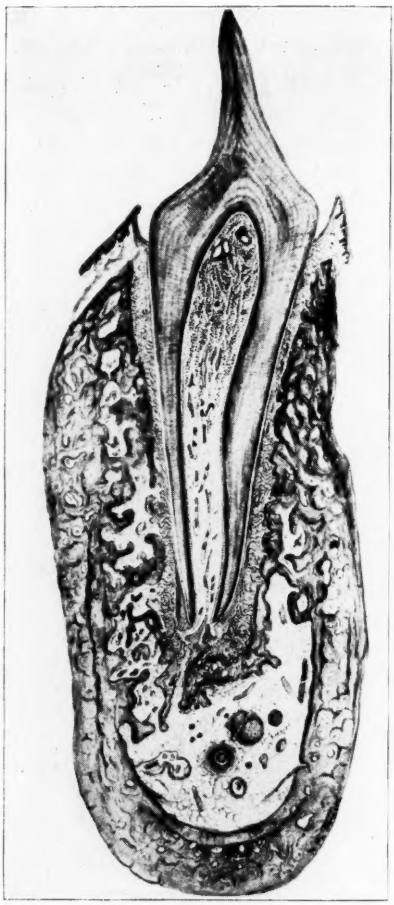

Fig. 2.—Section illustrating inflammatory reaction which occurs within pulp as a result of exposure by dental caries.

Figure 2 represents the conditions commonly found in cases of vital pulps which have been exposed by dental caries. From a purely clinical view, many of these behave as normal pulps—that is, the patient does not complain of pain—while many others may be hypersensitive. We see here that the pulp tissue presents a picture quite different from the preceding illustration. In the pulp chamber, we find evidence of local abscess formation with a marked increase in the cellular elements and degeneration of the odontoblastic layer in that region. The thin-walled blood vessels are dilated, some containing thrombi, and there is a marked cellular

Fig. 3.—Shreds of pulp tissue and odontoblasts clinging to wall of canal after pulp removal.

proliferation throughout the region.

Owing to the nature of the bacterial invader and to the local conditions, we find that the usual cellular response is that typical of all chronic infections. In the first half of the root portion, the condition of the pulp is somewhat changed. Some of the vessels are dilated; that is, the vasoconstrictors have lost their power, and the cellular proliferation is not so marked, although many mononuclear leukocytes are found. This inflammatory reaction is the defense which separates the infected areas from the normal tissue. In the apical third, the tissue is quite normal, since it is the farthest removed from the point of irritation, and therefore the last to be involved. This presents the brief review of the more common pathologic processes found in the exposed vital pulps; also, it possibly suggests why we recommend the thorough cleansing of the cavity and the placing of a mild antiseptic dressing prior to pulp removal. It also suggests why we find a too large percentage of failures following the removal of pulps in which the anesthesia was secured by cocain pressure.

May I briefly call to your attention some of the problems which a general surgeon must consider before he operates for the amputation of a leg or arm as a result of either a diabetic gangrene or some extensive injury. First, he must determine to what extent the blood vessels supplying the part have been involved, and how far from the lesion he must go to find the vessels uninvolved. Secondly, he must determine whether, at this point, there is a sufficient collateral circulation to insure healing of the operative wound and, if not, at what more central point the collateral circulation is sufficient. He plans the site of amputation largely by the consideration of these facts. We find in our own case that, if the pulp is amputated within the region of the dentinocemental junction, the site of operation is within the region that is the last to be involved by degenerative processes, and also at a point where the best possible collateral circulation exists.

Figure 3 shows the case shortly after pulp removal, with the attending tissue reactions. Along the surface of the canal, there are areas in which remnants of odontoblasts and shreds of tissue are still present. Even in those cases in which the pulp appears to have been removed *en masse,* we find shreds of pulp tissue clinging to the dentin. At the site of amputation (Figure 4), there is a layer of necrotic tissue beyond which is an area of inflammation that reaches out into the small apical terminations and may even extend into the periodontal membrane. The removal of this necrotic material is accomplished by phagocytic cells, chiefly the mononuclears, which engulf these particles within their own substance as well as furnishing a proteolytic ferment. This is the method by which the body removes

Fig. 4.—Higher magnification of apical region shown in Figure 3. *D,* dentin; *C,* cementum; *P,* periodontal membrane; *N,* necrotic tissue; *I,* developing inflammatory reaction in apical canals.

dead or injured cells and repairs the damaged parts.

It is to be distinctly understood that an area of inflammatory reaction surrounds any clean operative wound or sterile foreign body, and that the presence of this inflammatory process is not indicative of a septic condition. We can readily see from the last two illustrations why a careful curettement of the canal is always necessary after the removal of the pulp; also, why a measurement control should be established in order to avoid further mechanical injury at the site of amputation. The selection and application of drugs should be made in the light of the existing tissue changes. The presence of the inflammatory reaction should be considered as a favorable and not as an unfavorable manifestation.

Fig. 5.—Inflammatory reaction extending to the periodontal membrane. Phagocytes are removing the dead and injured tissue.

Inflammation has been defined as "a complicated vascular and cellular re-

sponse, which follows almost immediately upon the injury, and is adapted, by bringing much blood to the spot, and pouring out its elements upon the injured tissues, to prevent the extension of the injury, hold in check the injurious agent, or even destroy it." The débris of dead and injured tissue is removed by the action of those cells brought in during the inflammatory process. This reaction is not alone confined to the soft tissue but may extend to the surface of the canal.

In Figure 5, we find the inflammatory reaction extending into periapical tissue. Accompanying such a process, we find areas of resorption beginning at or near the root end and progressing into the canals, often reaching to the level of the root-canal filling. (Fig. 6.) This resorption of calcified tissue in some in-

Fig. 6.—Resorption of root end and along the lateral surface of the canals shown at *R*. *G*, guttapercha root-canal filling.

stances may arise because this particular area of dentin or cementum is not a suitable soil on which to build the work of repair and, again, the resorption materially enlarges the apical ramifications, permitting a much greater blood supply to dontal membrane than pulp, and progresses inward to the site of operation. As resorption is in progress in the root end, frequently we find a similar process within the portion of the alveolar bone directly opposite. (Fig. 6.)

Fig. 7.—Reparative process. *F*, fibrous tissue in canals; *S*, secondary repair calcification; *R*, extent to which resorption progressed as shown in Figure 6; *E*, embryonic connective tissue; *G*, root filling material.

the tissue within the operative area. It appears that resorption begins either on the outer surface of the root or near the end of the terminal branches, where the soft tissue more nearly resembles perio-

It is this resorption of the alveolar bone together with the accompanying proliferation within the apical periodontal tissues that produces the radiolucent areas in the roentgenographic examina-

tion. After pulp removal, the cellular reaction found within the area of the periodontal membrane, as a rule, is not nearly so marked as that found at the site of operation. As was stated before, this inflammatory reaction is a defensive and healing measure; therefore, we should give the tissues involved full sway. After the pulp canal has been cleared of all necrotic tissue and débris, this vascular and cellular response will gradually subside and many of these same cells will develop into young fibroblasts.

Before placing the filling material, we should make sure that the more acute reaction has passed. This is indicated by the absence of both an excessive amount of inflammatory exudate in the canal and soreness of the tooth to percussion. While it is not considered good practice to wait until all of the reactions described have taken place before filling the canal, suffi-

Fig. 8.—High-power drawing, taken from region *E* in Figure 7, showing polyblasts gradually acquiring the structure of fibroblasts; the transitory stage from inflammation to fibrous tissue.

cient time should elapse between pulp removal and insertion of the filling to permit the operator to have ready access to the area. When the filling material is inserted, care should be exercised to prevent additional injury to the vital stump either by instruments or by carrying the filling material beyond the point of amputation. The guttapercha should be carefully packed to adapt itself to all the irregularities of the canal. When either the sealing agent or the permanent filling is placed in the crown portion of the tooth, the occlusion should be very carefully considered so that the tooth may be free from all abnormal stress. As the reaction subsides, indicating that all obnoxious material has been destroyed or rendered inert, we find the reparative processes developing.

Fig. 9.—Reconstruction of apical tissues. *S*, repair calcification filling in all areas of resorption in cementum and dentin, also surrounding guttapercha filling; *F*, fibrous tissue with adequate blood supply in lumen of canals.

In Figure 7, the inflammatory reaction has given way to a process which is distinctly of a reparative nature. The areas of resorption, within both the alveolar bone and the outer portions of the canals, have been filled in with a new deposit of a calcified tissue, which materially reduces the size of the canals. Also, the soft tissue within the extreme apical portion of the canals has the same structure as the surrounding periodontal membrane; i. e., it is a fibrous tissue. At this stage of the repair, the soft tissue found in the vicinity of the filling material presents a slightly different picture from that seen within the apical openings. This difference is purely the result of the age of these structures. Figure 8 is a detailed high-power drawing of the tissues near the root filling. We see here, in cross-section, the transition from the inflammatory cells to those cells which are responsible for the reconstruction, namely, young fibroblasts. Maximow[1] demonstrated the transformation of inflammatory cells into fibroblasts. Strictly speaking, this is not as yet a fibrous tissue, but an embryonic connective tissue. The fibrils are not arranged in a definite direction. The fibroblasts are large, with a considerable amount of protoplasm surrounding the nucleus, and collagenic material, which is so characteristic of adult fibrous tissue, is absent. In the repair of wounds, the newly formed connective tissue first appears as an embryonic type, and as such has unlimited possibilities of growth. In Figure 7, it is to be understood that the fibrous tissue seen in the more apical portion of the canals, and in that part of the periodontal membrane which was involved in the inflammatory reaction, passed through this stage of repair. In Figure 9, all the areas of resorption along the lateral surface of the canals have been filled in with a calcified material and the guttapercha filling has been separated from the soft tissue by a similar deposit.

It now appears evident that the resorption and rebuilding which occurs within the entire apical region, after pulp removal, is the result of these tissues adapting themselves to the new conditions; also, that alternate periods of resorption and repair may continue for some time at first one point and then another, until the apical structures have been remodeled in accordance with their present needs. After pulp removal, the demand for an abundant blood supply within the tooth is materially reduced; therefore, the rebuilding along the surface of the canals frequently continues until the lumen is only of sufficient size to meet the circulatory needs of the remnants, which may undergo a marked atrophic degeneration, requiring then even less nourishment. Whenever the apical periodontal membrane and the soft tissue within the canal from the filling to the root end are entirely free from all evidence of inflammation, we say the case has healed. By following a careful operative technic, and using a plan of treatment which is compatible with the defensive mechanism of the body, we have been able to secure a reasonable percentage of success as measured by both clinical and microscopic evidence.

As I stated in the beginning, the purpose of this presentation is to enable the general practitioner to visualize the changes which occur within the apical tissues after the removal of vital pulps under ideal conditions and it is not intended to be an academic discussion of the pathologic principles involved.

1. Maximow, A. A.: Morphology of the Mesenchymal Reactions, Arch. Path. & Lab. Med., 4: 557-606.

THE PULPLESS TOOTH*

By LE ROY M. S. MINER, D.D.S., M.D., Boston, Mass.

NOTWITHSTANDING the fact that the pulpless tooth has been the subject of intensive study and ardent discussion for several years, it remains a problem of serious importance to a large majority of dentists throughout the country. The program this morning suggests the accuracy of this statement.

Enthusiastic advocates of root-canal therapy, who feel that refinement of technic can conquer all difficulties (or nearly all), together with those who feel that the pulpless tooth is innocent of the charges against it of being an enemy of its host (and there are such ultraconservatives), do not recognize the existence of any real difficulty here. And those who are devoutly impressed by the important rôle assigned the pulpless tooth in the drama, yes, the tragedy, of focal infection, see but one course of action. Both these groups agree only as regards the absence of a problem. While the former feel that any tooth, so long as it may render a cosmetic or mechanical service, may be retained, the latter insist that all pulpless teeth, irrespective of mechanical or cosmetic consideration, or of clinical findings, must be removed.

It is obviously impossible for both of these directly opposite points of view regarding treatment to be wholly right. What many seek and what all eventually must be able to do is to determine with reasonable accuracy under what conditions a pulpless tooth may be retained, and under what conditions it should be removed. The application of broad biologic principles must be the foundation on which the solution rests. The groups already referred to view the situation almost entirely from a local point of view and that largely a mechanical one.

Those who would retain a pulpless tooth to the bitter end (I almost said to the diseased end) feel that, by procedures essentially mechanical, the dentin and periapical areas can be sterilized by the efficiency of their technic in the root canal. On the other hand, those who would eliminate all pulpless teeth maintain that all teeth in this condition are infected; that it is impossible to sterilize dentin and periapical areas, and that, therefore, they are a menace to physical well-being. But do either of these points of view make any application of known biologic principles? Are the systemic or physical factors given due consideration? Is the present-day knowledge of immunology utilized? The answers to these questions appear obviously to be in the negative.

The purpose, then, of this paper is to emphasize the need of a deeper appreciation of the systemic relationships involved in the pulpless tooth problem. An essentially new piece of evidence will be presented, and a comparatively new teaching method now in use in the Harvard University Dental School will be discussed briefly, as one of the measures cal-

*Read at the Midwinter Clinic of the Chicago Dental Society, Jan. 16, 1929.

culated to help emphasize these important physical relationships.

The establishment of the existence of an efferent and an afferent circulation in teeth is important in the problem of the pulpless tooth and is closely related to its systemic aspects. More than one hundred and fifty years ago, John Hunter, English scientist and surgeon, the bicentenary of whose birth we have just celebrated, wrote in his "Natural History of the Human Teeth":

> From these experiments it would appear that the teeth are to be considered as extraneous bodies with respect to circulation through their substance, but they have most certainly a living principle by which means they make part of the body and are capable of uniting with any part of a living body.

Many experiments since Hunter's time have proved what he surmised but could not demonstrate.

A recent series of experiments, yet unpublished, by Weisberger of the Harvard University Dental School, are noteworthy in this connection. Antigen in the form of protein in horse serum was sealed in teeth of guinea-pigs; in some of the animals, openings being made to the pulp, and in others, only in dentin. Antigen was used in amount as low as one thousandth cubic centimeter. Anaphylactic response in the uterine smooth muscle was obtained after eight days. The hypersensitive state was found still to be present after three months, and the duration is probably longer. Weisberger concludes that the tooth can act as a medium for the transportation of antigen to the general circulation, which, in turn, can sensitize remote tissues of the body and produce a hypersensitive state in these tissues. These results indicate also that a vital tooth showing caries may be as important in developing hypersensitivity as a tooth showing a more profound pathologic process.

In the study of circulation to the dentin, experiments by Howe are significant. He reports that the teeth of guinea-pigs fed lead acetate showed lead:

> Lead could be seen in the tubuli and interglobular spaces and appeared to be diffused in some areas in the tooth substance, particularly in human teeth where the effects by lead were of longer duration. The enamel in one of those cases appeared to be stained in areas situated on the dentinal side of the enamel.

Ferrous lactate was fed to the animals weighing from 550 to 750 gm. and iron was recovered from teeth in thirty minutes.

These experiments by both Weisberger and Howe prove how intimate is the relation of tooth structure to the rest of the tissues of the body, and indicate how important these systemic relations must be in any abnormal state, particularly when the nutrition of the tooth is modified or interfered with.

The importance of the pulpless tooth revolves largely around its being a primary focus of infection, with a consequent capability of producing secondary symptoms. When this subject is considered from a systemic standpoint, the biologic principles involved are the same as in any phase of infection. Probably the most important factors here are the virulence of the organism and the resistance or immunity of the host. Kolmer says:

> In all infections there are two separable factors to be considered: *first,* the offensive forces of the infecting agent, dependent upon its pathogenic or disease producing nature and its power of defending itself against the antagonistic forces of the host, and of thriving under these conditions; *second,* the resistance offered by the host, mainly dependent upon certain physical factors, non-specific local factors, and specific antibodies which constitute the defensive mechanism or immunologic factors. The former concerns infection, the latter immunity.
>
> Parasites and host may live together in apparent harmony, owing to the ability of

Harvard University Dental School

Case No. ..... Infection Susceptibility Index Chart X-Ray No. .....

Patient's Name ..... Age .....

Address ..... Sex .....

Tel. ..... Physician's Name ..... Advice .....

Patient's Chief Complaints		Present History	Past History	Family History
I Own or Inherited Susceptibility	Rheumatism			
	Joints Swollen			
	Joints Deformed			
	Muscular Rheumatism			
	Lumbago			
	Neuritis, Sciatica			
	Shingles			
	Chorea			
	Nervous Breakdown			
	Mental Cloud			
	Headaches			
	Heart Lesions			
	Arterio Sclerosis			
	Kidney Lesions			
	Liver and Gall Bladder			
	Stomach and Intestines			
	Eye, Ear, Skin			
	Anemia			
	Lassitude, Chills			
	Slight Fever			
	Blood Pressure			
II Resistance	Influenza or Tuberculosis			
	Pregnancy, Lactation			
	Over and under-nourished.			
	Exposure			
	Grief, Worry, Fear			
	Age, Habits			
	Common Colds			
III Foci other than Teeth	Tonsils, Throat, Ears			
	Adenoids			
	Catarrh, Sinuses			
	Auto-intoxication			
	Dyspepsia			

Recapitulation from data opposite	+or−
I. Is patient susceptible to diseases listed ?	
II. Is patient resistance temporarily low ?	
III. Has patient foci other than dental at present ?	
SUSCEPTIBILITY INDEX Plus answer to I only, susceptibility + (high) Plus answer to II only, susceptibility ± (uncertain) Plus answer to III only, susceptibility − (low) Plus answer to any two or all, susceptibility +	

Special Data

Mouth as a whole:

Past History (major operations, etc.)

Remarks:

Data complete Date .....

Student ..... Instructor .....

Chart prepared for use in the root canal clinic at Harvard University Dental School.

the host to restrain the activity of the parasite and neutralize its injurious products, or to the absence of infectivity on the part of the parasite until the vital resistance of the host is diminished, or the pathogenicity of the parasite is increased. When either of these things occur, neutral relations are disturbed, and infection occurs. When active symptoms occur, we are apt to speak of there being a virulent infection. Virulence, however, refers primarily to the characteristics of the parasite, while resistance, or immunity, denotes a state of the host.

Falk says:

In any circumscribed series of comparable observations, virulence is never known, probably cannot be known, except as a reciprocal measure of resistance. The host for which a microbe displays virulence is relatively non-resistant. The microbe to which a host shows high susceptibility is virulent. The trend of research is to indicate that parasitic virulence and host resistance are related, and not independent variables. Virulence, therefore, varies reciprocally, as resistance or immunity.

The subject of infection, then, must form the basis for the study of immunity, for usually infection must have occurred in order that immunity be present. Specific antibodies, for systemic protection, are produced only by stimulation of the body cells, and this stimulation is furnished by the infecting agent, either in living or disease producing form, or in a modified or an attenuated state. When dentin or periapical areas are invaded by bacteria, whether or not secondary symptoms appear as a result of that invasion is dependent on both bacterial virulence and host resistance, or immunity. We have seen that virulence is never known, and probably cannot be, except as a reciprocal measure.

On the immunity side, it is important to note that there is a noticeable lack of immunity to disease caused by gram-positive organisms, the types most frequently found in these dental cases. Further, we have no evidence that any active immunity is established by the chronic dental abscess. On the contrary, there seems to be a tissue hypersensitivity in many cases, which may be explained on the basis of Weisberger's experiments. The constitutional and joint reactions, or "flare-ups," which occur after active dental interference, suggest that this state of hypersensitivity has been developed.

Today, we have no exact methods of measuring the resistance of a patient, for here again, conversely, virulence complicates the purity of attempts to obtain exactness. We can make very fair estimates, from the general appearance and physical examination of the patient, supplemented by his family and personal history.

In order to emphasize to students as definitely as possible the importance of these physical factors, when considering the question as to whether a given pulpless tooth should be treated conservatively, or extracted, and as a means of obtaining and recording family and personal histories, an infection-susceptibility index chart was prepared for use in the root-canal clinic of the Harvard University Dental School. This is a modification of the susceptibility chart offered by Price.

The terms used in the chart were purposely not too technical, so that when students were asking direct questions, they would be understood by the patient. It seems doubtful that any chart of a mechanical nature would be of great value if judgment were to be rendered only by a mechanical addition of plus signs and minus signs. It is essential, however, that students and even established practitioners obtain all possible points of information, and a chart will be of material assistance to this end.

The physical examination which supplements the information obtained

through the use of such a chart as has been presented should show the present condition of the patient; whether the patient could hope to combat infection successfully or ward off disease, and whether vital organs were in danger of overstrain in trying to function with focal infection present or whether they might contribute to the control of parasitic activity. If lesions of the heart, kidneys, pancreas and other structures were found, resistance would probably be low and could not be relied on to control a dental lesion.

An analysis of the patient's habits and environment, general hygiene, diet, etc., is of material assistance in an evaluation of resistance, for in a borderline case, with excellent habits and environment, the patient could not carry any more load. If this load is added, trouble ensues, and that is exactly what happens in some of these pulpless tooth cases.

When we approach this problem from a surgical point of view, physical diagnosis remains an important factor. The best surgeons, surgeons who have advanced that science most, are great, not primarily because they are clever technicians, but because they are able diagnosticians and pathologists. They do not operate because somebody advises it, but only after a case has been carefully studied in detail and the findings, as a result of that study, indicate a need for operation. In determining the management of pulpless teeth, when more care and attention is given the patient's physical condition, when more careful efforts are made to evaluate resistance, fewer teeth will be needlessly interfered with surgically, and more teeth that should not be treated otherwise will receive surgical attention. In other words, we will more efficiently determine when to be conservative and when to be radical.

I am reasonably sure that some within the sound of my voice are thinking that what I have said may be good theory but is entirely impractical in the everyday practice of dentistry. It is my experience, extending over some years, that patients welcome this kind of service, and immediately the value of dental service is raised in their minds.

The need of a greater appreciation and a more adequate knowledge of physical diagnosis and the medical aspects of dentistry has been recognized by leaders in some of our dental schools. How much training in medicine should be given; how it should be given; where, and by whom is now being actively discussed. The English lead us in this phase of dental education, for clinical clerkship and ward walks in the hospital are a part of their dental training.

Employment of physicians in the dental clinic in making physical examinations for root canal, periodontia and other types of cases is one method of developing an appreciation and knowledge of medical relationship. It is being tried out in the Harvard University Dental School.

To make any medical training in dentistry effective, the cooperation of the medical man is necessary. As a corollary to the question as to how much medicine should be studied by the dental student comes the question as to how much dentistry or training in oral problems is necessary to the medical student. There is no doubt that this training is necessary, and its lack has been a deficiency in medical education. The three medical schools in Boston now give some training in oral pathology and its clinical application; which is hopeful for the future.

The pulpless tooth is only one of the problems in dentistry that has important

medical and physical relationship. We know little about the effect of primary systemic disturbances and physical deficiencies on the teeth and their supporting structures. Until dentists as a whole become more conscious of the breadth of their field, become more physically minded, and appreciate the need of a knowledge of the whole before they can be truly expert in any one part, and until mechanics in dentistry is the servant and not the master of biologic principles, the broader developments in dentistry will not take place and the pulpless tooth problem will remain in the unsatisfactory condition that it is today.

HEREDITARY HYPOPLASIA OF THE DENTIN*

By GEORGE W. WILSON, D.D.S., F.A.C.D., and MATILDA STEINBRECHER, B.Sc., Milwaukee, Wis.

AS an introduction to this report on what seems to me† to be a most unprecedented and perplexing dental deformity, it seems expedient that a common point of view be at once established, in the interests of a more thorough discussion and a more profitable mutual understanding of this extraordinary condition.

Because of the confusing characteristics exhibited, and the inability to find anything in the literature comparable to the case, no definite conclusions have been reached. Again, the nomenclature employed may be found erroneous, unsuited or incomprehensive, and a change be deemed advisable. In view of the fact that we must, of necessity, attach a name to the condition and for purposes of discussion, I shall name it, for the present at least, a case of "hereditary hypoplasia of the dentin." I shall divide this report into four phases: 1. The revelations of the clinical examination. 2. The revelations of the roentgenographic examination and the family history. 3. The disclosures of the laboratory examination. 4. Summary and suggestive questions for discussion.

About five months ago, a lad, aged 14, of average healthy appearance, presented himself at the clinic of Marquette University Dental School for prophylactic treatment. He was assigned to a student hygienist, who, after an hour of fruitless effort, reported to the supervisor that she could not remove the stain from the patient's teeth. On investigation, a very unusual condition was evident, and the patient was referred to the special examination room for further investigation. Clinical examination disclosed the following conditions:

1. The crowns of all the teeth were dark, bluish gray, homogeneously (not mottled enamel).
2. All the teeth except the third molars had erupted, in an approximately normal position.

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research), at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 23, 1928.

†Dr. Wilson presents the clinical phase of the case studied.

3. The size of the crowns were about normal.
4. The superficial tissues were apparently normal and no lesions were present.
5. The upper left central incisor had been fractured at the cervix about one year previously. (This tooth was later extracted and used for microscopic examination.)
6. The lower left first molar was badly broken down and was carious. (This tooth also was extracted and used for microscopic examination.)

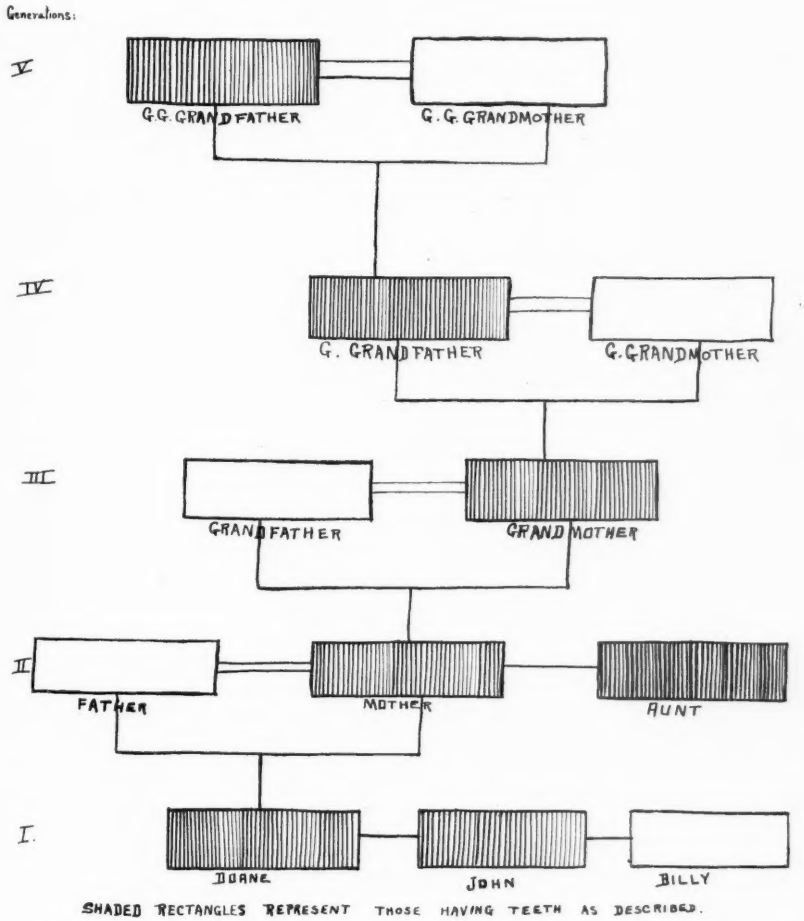

Fig. 1.—Family tree of D. B. Shaded rectangles represent members of family having teeth as described.

7. The upper left first molar was carious on the mesial proximal surface. No further caries were present, and there were no fillings in the other teeth. (Note the absence of caries.)
8. The electric test indicated vitality in all teeth except the lower left first molar. (The fractured upper left incisor responded slightly to the electric test. This may have been an error, the response coming from the gingival area.)
9. During transillumination of the crowns, the effect of excessive pigmentation appeared to be neutralized and the crowns of the teeth presented an average normal color.
10. Transillumination of the roots revealed a normal condition of the investing tissues, except in the area adjacent to the lower broken down molar and fractured upper incisor.
11. Examination of the cavity in the upper left molar revealed a reddish brown discoloration of the dentin, which resembled the rust in the bottom of a tin water bucket. The dentin could be easily peeled away with an excavator. The texture of the dentin was much like carious material. This excessively pigmented material was removed to within dangerously close proximity to the pulp with no change in color or texture. (Subsequent microscopic examination proved hyperpigmentation of the entire dentin.) It was not hypersensitive.
12. There was no evidence of serumal or salivary calculus formation.

Fig. 2.—Fractured upper left central incisor which was used for microscopic purposes.

Revelations of the roentgenographic examination were as follows:

1. There was hypoplasia of all roots. The deformity was roentgenographically one of size, in that they were abnormally small in proportion to the normally formed crowns; beginning abruptly at the cervix and indicated lines of accretion on the upper central incisors.

Burchard defines hypoplasia as follows: When teeth are malformed through some abnormal developmental process, due to an arrested development, the condition is termed hypoplasia.

Endleman: Imperfect, insufficient or misdirected development of a part, resulting from abnormal influences during intra-uterine life or during developmental periods after birth, is called a hypoplasia.

Black: A contemporaneous accretional deformity—a dystrophy in which all portions of the teeth in process of formation at a particular time are imperfectly formed along the lines of normal accretion or growth.

The foregoing definitions are presented to justify at least partially the use of the word hypoplasia as employed in this report.

Fig. 3.—Anatomic form of teeth of D. B. The roots are hypoplastic and the crowns apparently normal.

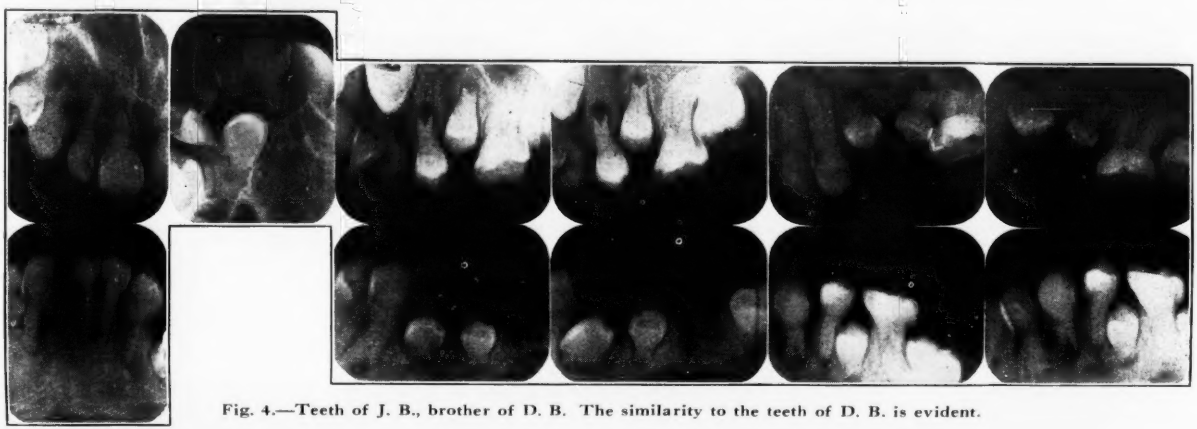

Fig. 4.—Teeth of J. B., brother of D. B. The similarity to the teeth of D. B. is evident.

2. There were minute, indefinite root canals. In some teeth, the canals were almost imperceptible.
3. There was a distinct line of demarcation between the enamel and the dentin, probably due to the excessive pigmentation in the dentin.

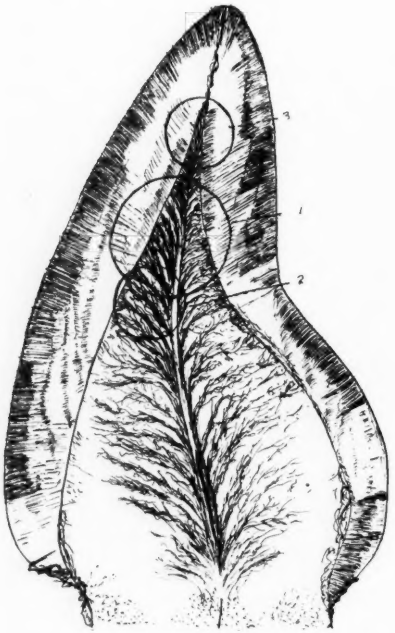

Fig. 5.—Sketch of the crown of the upper left central incisor. This tooth was extracted because it was fractured. It reacted slightly to the vitality test. The circles represent the portions of the tooth of which photomicrographs were made. The pulp chamber is absent and there is almost a total absence of dentinal tubules in the labial and lingual aspects of the gingival area. The tubules extend from the center of the tooth quite vertically instead of horizontally as in the normal dentin and cluster and branch as they extend upward toward the incisal portion. The enamel is very similar to normal enamel. The area circumscribed by the larger ring is shown in Figure 6.

4. Horizontal fracture of upper left central was noted at the cervix.
5. There was degenerative change in the apical area of the lower left broken down molar and fractured upper central incisor. Further investigation of the case revealed the following history:

1. D. B., aged 14, the patient, is the oldest of a family of three healthy boys, of average build with skin inclined to be brown and hair sandy in color.
2. J. B., aged 9, one of the brothers, on examination was found to have an exactly similar tooth deformity in both deciduous and permanent teeth, skin inclined to be brown and hair sandy in color.
3. The third brother, B., aged 3, was entirely free from the deformity. His skin and hair were lighter.
4. The deciduous teeth of D., the first of which erupted at the age of 7 months, and J., gave a history of a similar deformity, while the deciduous teeth of B. were normal (no caries).
5. The parents were living, in poor circumstances, and of average health.
6. D. was breast fed, and later had plenty of milk in his diet.
7. Childhood diseases experienced by the patient were: whooping cough, at 8 months, scarlet fever, and measles, at 10 years.

Family History.—1. The maternal ancestors, of English descent, came over on the Mayflower, settled in Boston, and later moved to Nova Scotia.

2. The paternal ancestors came to this country about the same time, settled in New York and later moved to Nova Scotia. They were of Bohemian descent.

There was no history of the deformity in paternal ancestry.

3. The great grandparents and grandparents (maternal) lived on an ancestral estate in Nova Scotia and were farmers. Their food consisted of meat, wild fowl, fish and plenty of fruit and vegetables.

4. The water supply was from a well which was brought to the surface with a wooden bucket. Mrs. B. remembers a reddish brown stain being constantly in it. The water had an iron taste. The water was often riled. It was of a reddish brown color like rust and was supposed to have its source in the Roseway river.

5. The maternal grandmother, grandfather, and great great grandfather, five generations back, had discolored teeth, which were called "water teeth" by the family physician.

6. The mother recalls other inhabit-

Fig. 6.—Low power photomicrograph of the dentin near the incisal edge (area circumscribed by larger ring in Figure 5). (× 220.) The large size of the tubules and the tuft formation should be noted.

ants in the neighborhood with similarly discolored teeth.

7. There was no history of close intermarriage or of pathologic taint.

8. One sister of Mrs. B. had similarly discolored teeth, while the teeth of an older sister showed no discoloration.

9. Mrs. B. gives a history of hypoplasia and hyperpigmentation, with little or no caries. The teeth were gradually exfoliated, presumably because of lack of sustaining power to stress, and she is now wearing dentures.

10. When 19 years of age, Mrs. B. moved to Florida, where she lived during the early months of her first pregnancy; i. e., before the patient's birth. The diet during this time was fruit, vegetables and fish, but no milk. During the last four months of gestation, she lived in Milwaukee.

11. There are gold and coal mines,

Fig. 7.—High power photomicrograph of dentinal tubules (compare Figure 6) showing the primary and secondary curvatures of these tufts from the center of the tooth incisally outward.

and gypsum and lime deposits in Nova Scotia.

The results of the various laboratory tests made, including photomicrographs of ground sections of extracted teeth, crowns and roots, will be presented by Miss Steinbrecher who has conducted this phase of the investigation, after which I shall offer a summary and some queries.

Before presenting the photomicrographs,[2] attention is called to two articles that may have some application to the case here reported. Millican gives his conclusions on hypoplastic teeth in a study of 5,757 children between the ages of 5 and 14 years. In 267, that is 4.64 per cent, there was hypoplasia of the

Fig. 8.—Dentino-enamel junction of the upper left central incisor, some defects in the enamel and a crack probably due to grinding. The outer two fifths of the enamel has a stained appearance.

2. The laboratory findings are presented by Miss Steinbrecher.

teeth, the permanent teeth being affected in all but nine. The defects usually consisted of horizontal bands across the tooth surfaces, the enamel of which presented either deep or shallow brown pits, or was altogether defective in quality and deficient in quantity. The incisors and first permanent molars were most frequently affected. He stated that, in some localities, a deficiency of calcium content of the drinking water results in hypoplasia of the teeth, but in these, the causes were apparently general disease of infancy and early childhood, and malnutrition when insufficient or improper

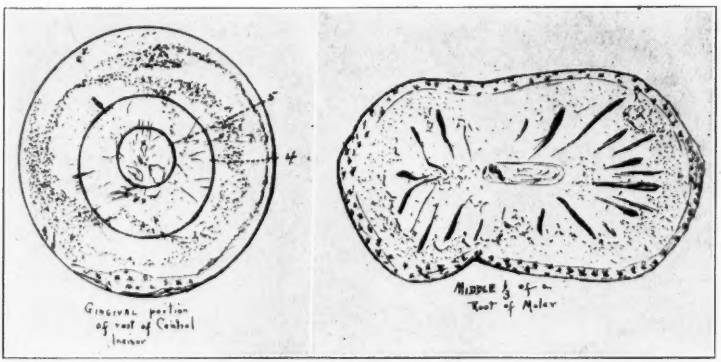

Fig. 9.—Sketch of the gingival portion of the root of a central incisor with two circles showing areas from which photomicrographs were made, and a cross-section of the middle one third of the root of the extracted molar. The slight remains of a pulp chamber and the excessive granulation are to be noted.

feeding resulted in rickets before 3½ years of age. Millican concludes that diseases of the respiratory system, in infancy and malnutrition are the chief causes of hypoplasia in teeth and that lack of breast feeding is an important factor.

The second article is by Theodore B. Von Beust, who claims that there are parallel rows of capillaries in the enamel which are the avenues through which metabolic fluids must course from the pulp to the enamel periphery. He says: "The agency causing the lesion enters enamel from without centripetally, traverses these capillaries, etches their walls and apparently dilates them. The agency attacks the rod from the lumen of the capillary, gradually breaking it down. The lesion can be duplicated experimentally by exposing teeth to various solutions. The agency follows the enamel capillaries, reaches and follows the dentinal tubules and attacks the interfibrillar dentin or matrix, producing mottling of the dentin. These facts are opposed to the developmental hypothesis of Black, Williams and others."

Referring again to the central incisor (Figure 5), in view of the fact that there is practically no pulp chamber; that the teeth respond to the vitality test; that the dentinal tubules are so much larger than normal, we thought it probable that the blood, nerve and lymphatic supply of the tooth is contained within these tubules and that the

visible color of the teeth is due to the blood supply in the dentin. Therefore, as shown in Figure 18, a small piece of dentin next to the enamel was chipped off and thoroughly washed in distilled water, and the benzidin test for occult blood made. A fragment of dentin from a normal tooth was treated in the same way as a control. The test tooth fragment responded immediately and perfectly, indicating the presence of blood, while the control showed a positive reaction only on the margin next to the pulp chamber. This seems to prove conclusively that the dentin exhibits a strange abnormal blood supply. If the large tubules contain the blood, lymph and nerve supply of the tooth in place of a regular pulp, the question of the abnormal color is solved. The remaining questions are these: Why isn't there a pulp chamber? Why is the root of the tooth so very small and vascular while

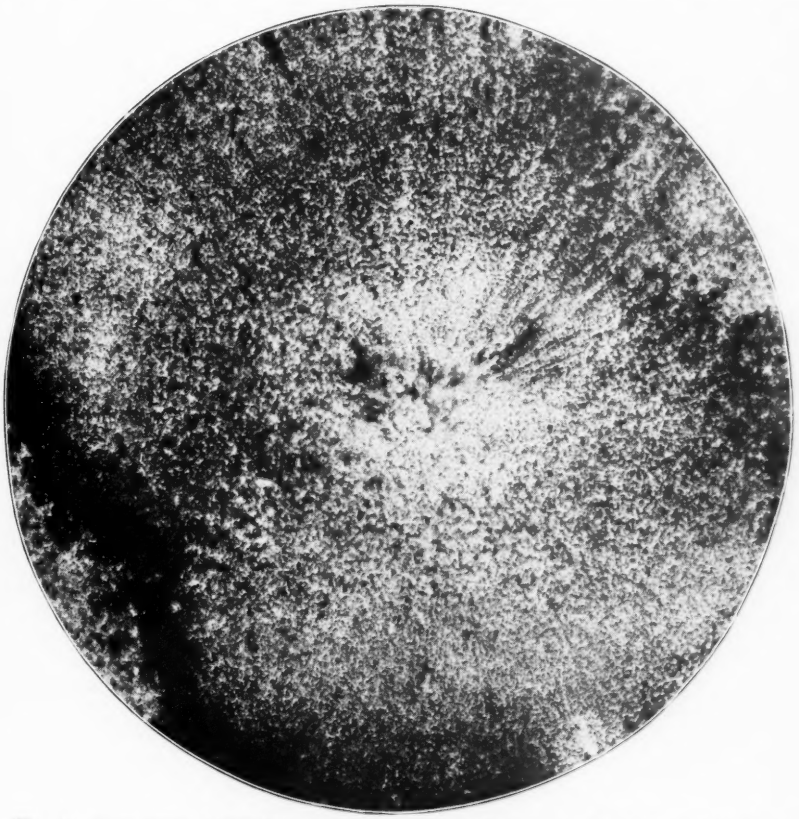

Fig. 10.—Low power photomicrograph of a very small area, showing the remains of the pulp chamber and the porosity of the dentin. (× 220.)

the enamel is so very dense, as demonstrated by the roentgenogram?

SUMMARY AND QUESTIONS FOR DISCUSSION

1. The term "hereditary hypoplasia" is employed in the title because it appeared probable that it may be a transmitted deformity. According to the history obtained, it has existed in this family for five generations.

2. I do not feel that we were at all justified in attempting conclusions in this report because of the unprecedented characteristics and strange phenomena exhibited, as well as the uncertainty of the regional and family history. There is still a vast amount of investigation necessary to justify conclusions.

3. We have reported a multiple deformity, existing in this family for five

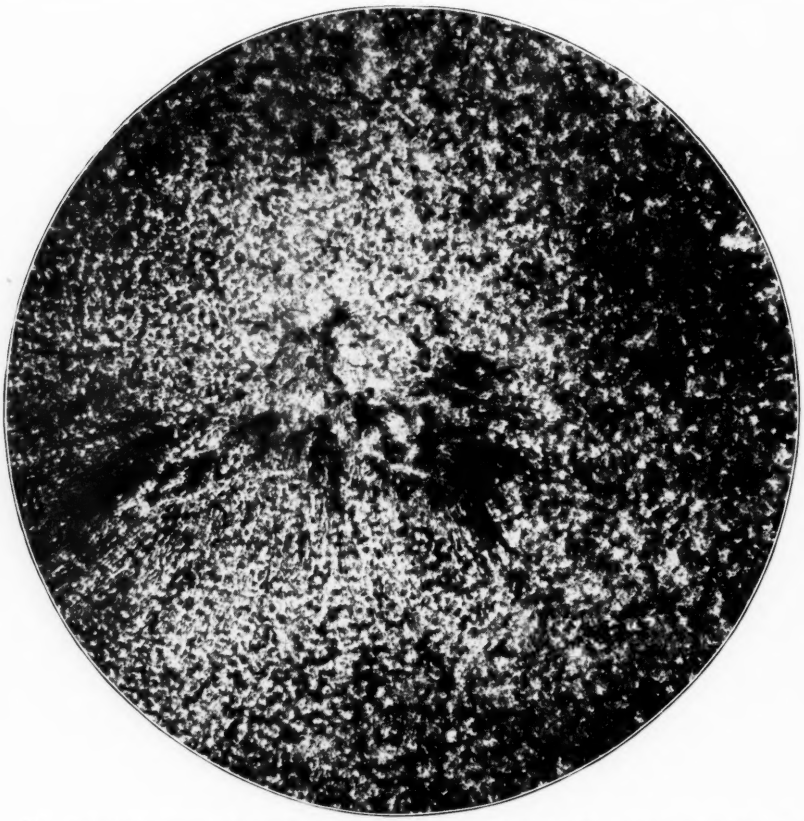

Fig. 11.—High power photomicrograph of the area shown in Figure 6, emphasizing the granular appearance shown, on close observation, to be due in large measure to the extreme waviness of the tubules and pores.

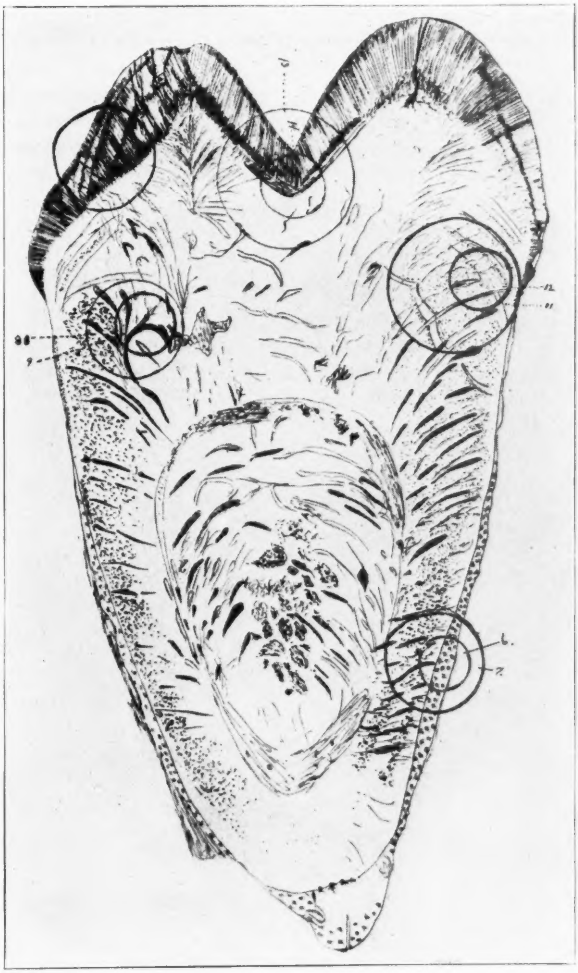

Fig. 12.—Longitudinal section of a molar. The circles designate areas of which photomicrographs are shown in Figures 13-21.

generations according to the history, involving abnormal color, structure and shape of enamel and dentin. The influence on the structure of the dentin is most interesting and is most difficult to understand.

4. The influence responsible for the condition was apparently continuous during the growth and development of all the teeth, including the deciduous teeth, down through the generations of this family, with a few exceptions. While

we cannot be sure of a structural change in the earlier generations, the history indicates a reasonable assurance of it. We have shown that the condition was similar both in D. B., the patient, and in J. B., his brother.

Fig. 13.—Dentino-cemental junction (low power magnification). In place of the narrow granular layer of Tomes, the entire dentin is granular and only here and there is an exceedingly large tubule seen. There are an excessive number of lacunae in the cementum.

5. We may suspect the deformity to be regional, for it was present in other families in the region in question, in Nova Scotia. However, both of these children, D. and J., were born distant from the region of Nova Scotia.

6. We may also point a finger of suspicion at the water consumed by these people: it may have been the primary cause. We have not as yet made a water analysis. What may such an analysis reveal? The old physician evidently suspected the water when he called the teeth "water teeth." (The children, D.

and J., had never had any of the Nova Scotia water.)

7. It seems reasonable to think that the dentinal coloration is due to blood in the large tubules, as reported by Miss Steinbrecher, and possibly other pulp tissues, and that if there were not a structural deformity, the coloration would be absent.

8. Even though we may account for the coloration, what are the influences which have brought about the structural change in the dentin and the anatomic form of the roots of these teeth?

Fig. 14.—High power photomicrograph demonstrating the irregular lamellae of cementum with lacunae and canaliculae quite numerous. Granulations in the dentin are excessive and there are a few dentinal tubules.

DISCUSSION

E. H. Hatton, Chicago, Ill.: One of my students recently has been working on the dental equipment of identical twins, and he and I are getting into interminable arguments with orthodontists and with other specialists of the profession who lay great stress on environment. We are gradually becoming less and less influenced by environment, and

are looking more and more to heredity for some of the things which many people believe are the result of external influences.

Theodore B. Beust, Louisville, Ky.: It is seldom that we find a report which is so thoroughly illuminating as the one just presented. The lesion that I have been working on, mottled enamel, does not correspond to the condition here shown. I do not think that you will find the solution of this case in any metabolic influences. One must consider heredity, not environment or external influences. The dentinal tubule-like structures I would pronounce blood vessels. The whole structure of the teeth shown suggests the presence of osteodentin. Frequently, pulp cavities of considerable size in human teeth, from some cause, become calcified, and we find blood vessels permeating the calcified structure; but in the case shown, we find the so-called tubules near the periphery of the dentin. That in itself could account for an abnormal coloration. The enamel would not necessarily contain pigment. I would like to examine the preparation to learn whether normal dentinal tubules exist be-

Fig. 15.—This low power photomicrograph shows a tubule extending occlusally, throwing off branches and bending back apically forming an arch. Distally from this tubule is a very granular area.

tween the larger vessels. According to the photographs, some appear to be present, but I have never heard of several tubules uniting to form single vessels. Areas presenting the appearance of osteodentin may be found in the teeth of the lower animals. In some teleosts, this is normal. I would be pleased to submit photomicrographs, taken from cow incisors, which present this structure. I am inclined to believe that we are here dealing with a heritable anomaly.

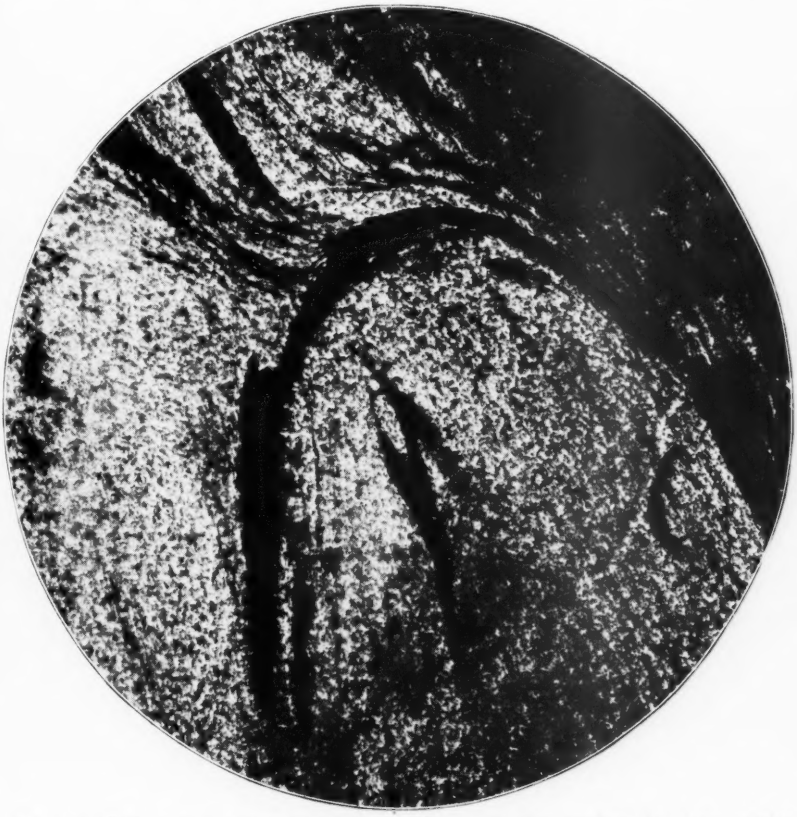

Fig. 16.—High power photomicrograph showing great size attained by these tubules. Compare with Figure 11.

Balint Orban, Chicago, Ill.: I have never seen a case like this. I should like to know something more about it. I should like to know whether there is any connection between the enamel spindles and the dentinal tubules. I believe that there is a kind of dentin which is called vascular dentin, and it may be that that is what we have here. But I can't tell whether there are dentinal tubules, or not. In some specimens, it seems there are some. It was very interesting, but I do not know any more about it.

Dr. Hatton: I would like to ask whether there was any history of convulsions at childbirth.

Dr. Wilson (closing): No, there was no history. We inquired as to that, as to every-

thing we could think of. We saw the mother about half a dozen times and wrote the grandmother. Our supervisor called to see the latter, but we were not able to get a history of anything like that. The grandmother did not remember any further back than the fifth generation. The condition might have existed before that.

Fig. 17.—Low magnification of a portion of gingival dentin showing striations which are probably due to variations in or arrested development.

Fig. 18.—High power magnification of the area shown in Figure 17.

Fig. 19.—Heavy brown stria of Retzius, with great irregularity of the dentino-enamel junction near the occlusal portion.

Fig. 20.—Low power magnification showing a fissure at the base of the enamel and a band of somewhat structureless dentin, possibly due to beginning caries.

Fig. 21.—High power magnification of the same area showing the fissures, gnarled enamel and band of dentin, carious or transverse in structure.

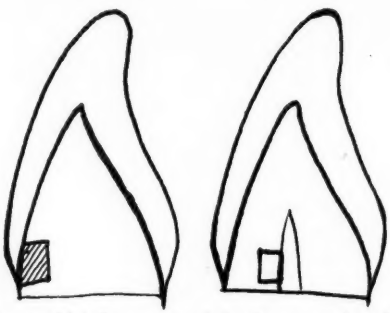

Fig. 22.—Location from which fragments of dentin were taken for occult blood test.

POSTOPERATIVE TREATMENT FOR PERIODONTOCLASIA, WITH SUGGESTIONS FOR SATISFACTORY RESULTS*

By ROBIN ADAIR, B. S., M.D., D.D.S., Atlanta, Ga.

THE postoperative treatment of periodontoclasia has undergone kaleidoscopic changes in the last twenty years. I entered the field about the time of the "success" of the younger postoperative treatment by lactic acid. This method, so extensively used, was rather short-lived, to be followed in quick succession by numerous measures involving the making of small flaps or big flaps or the removal of the entire flap for pocket protection after instrumentation. The reaction to this extreme was the adoption of the theory that no flap was necessary, and various methods were next tried of suturing to hold the gum in apposition to keep out food while healing. In this category could be placed the ingenious splints to hold the teeth steady until the gum healed. We soon learned that a tooth needing a splint should be removed, but often was savable, by correction of occlusion.

All medical and clinical agents in the pharmacopeia were tried. Various pastes and packs came on the scene. Many of these were most valuable and still hold a place in the proper armamentarium of the periodontist. The wax and paraffin pack technic should be tried by all. The zinc oxid and oil of clove pack is useful where much surgery has been done and there is considerable space between the teeth.

One of the oldest methods of pocket protection, given to the profession by my father about forty years ago, has been in continuous service, not only in his practice, but also in that of a goodly number of practitioners throughout these years. Although clinics and papers were presented on this method, it has failed to receive a general adoption on account of the very qualities which its users know to be its chief virtue: It is inexpensive to make, and it stains the teeth.

I am one of those who carry home, every few months, the extra instruments and equipment which they find out of use in their offices. However, it is a joy every few years to enter the junk room and ruminate among this collection. Only last week, I brought into service an amalgam mixer which had been discarded about fifteen years ago. So for the purpose of introducing this old preparation of my father's, I have gone back in his files, and here is a section of the paper he read before the senior class at Vanderbilt University in 1896.

POSTOPERATIVE TREATMENT

Dry off gums, protect tongue and cheeks with little strips of domestic bleaching, and apply my "Big Nigger" remedy, which I

*Read before the Section on Orthodontia and Periodontia at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 23, 1928.

consider the best for pocket and pus exuding cases of pyorrhea, known to the profession. This "Big Nigger" remedy is made in two separate bottles. The iodine preparation is made by putting crystal iodine in the bottle, say one-fourth full, then add pure wood creosote until you make a saturated solution; you want it as thick as syrup if you can get it that way, so it is best to have a little undissolved at the bottom.

The tannin preparation is made by getting a wide-mouthed bottle, pack it as full of tannin as you can, leaving just a little space at the top, then add glycerine and set aside for twenty-four hours. If the glycerine goes to the bottom of the tannin, it is just right, but if it does not, add a little more glycerine and continue to do so until the whole of the tannin is dissolved, and the preparation is about as thick as honey. These preparations are applied as follows: Tongue and cheeks protected, gums dried, two Donaldson's old n rve brooches previously entwined with absorbent antiseptic cotton, so that the end is covered and will not irritate the soft tissues, one is dipped into the iodine preparation and then applied over opening of the pocket, then wait a moment, take the other brooch and dip into the tannin preparation, and flow this all over the surface of gums and pocket, but do not run the brooch down into the pocket, only let it drop off on gums and flow. Then remove doilies and let the saliva flow over the gums, when a tannate of albumen or leathery coating will immediately be formed by the saliva all over the gums so treated, which will close these pockets, and keep them closed for twenty-four hours. So far as I know, this is the only remedy that is antiseptic, germicide, and astringent, and prevents food and other foreign substances from being forced down into the pocket and protecting the new cells that will be built up, resulting in new tissue being formed.

It can fill an important place in the postoperative care of many cases, and its proper application will tide the dentist over many a questionable case.

END-RESULTS IN PERIODONTIC TREATMENT

When I had almost finished the preparation of a paper for this occasion, I received a letter from a dentist containing this statement: "As you know very well, the habit at a convention in the Periodontia Section is to engage some well known figure in that specialty to demonstrate some spectacular operative measure for the cure of pyorrhea." And he asks the question, "What good does that do for the everyday practitioner?" The question suggested a new line of thought; and from this a different presentation of my subject has resulted. Following this lead, I shall take up some of the most common questions asked the periodontist.

No matter what treatment or method we use, the question of end-results is of prime importance. Having, like so many of you, run the gauntlet of methods which at the time I considered assured a "successful cure," only next month to take up something new, I am delighted to see what now looks like a real sun rising on the horizon. A unity of purpose to standardize the technic and assure our operation a successful end-result is, I believe, about to be established. When so large a number of dentists reply at length to a questionnaire and seem to be in accord on several findings, we would seem to have arrived whither we are traveling.

These questionnaires were sent, first, to periodontists of reputation; and, secondly, to many general practitioners in every state in the Union. A smaller number were addressed to exodontists with this note: "As the physician now often learns the true diagnosis of his case at the necropsy, so you can tell us something about our end-results after the treatment of pyorrhea."

The many frank replies furnished enough material from which to write a book on the various questions. In the

short time at my disposal, I shall attempt to correlate the general opinions as expressed by these answers in the hope that the information will prove as useful and valuable to others as it has to me. To know what the other man thinks and does gives us an incentive to action. We might know a thing ever so well, but unless we put it into practice, it would be of no real value.

CORRELATED ANSWERS TO QUESTIONNAIRE

Question 1.—The dental profession is still skeptical about reported cures for pyorrhea. Do you think the results from present methods of treatment justify a complete change of opinion?

Replies.—In the strict sense and use of the word "cure," there is today *no cure* for pyorrhea. (A. G. Smith.)

I think that we will have to change our methods of treating pyorrhea. (J. S. Hoffman.)

No, room for improvement. (J. S. Plaxco.)

I consider results as obtained by conservative treatment justify a complete change of opinion as regards former doubt as to the permanent cure of suppurative periodontoclasia. I find it to be a curable disease. (Benjamin Tishler.)

An exodontist says, "Both the dentist and the patient should remain skeptical." (H. M. Davis.)

I believe it to be true that the dental profession is in a large measure skeptical as to the possibility of success in the treatment of pyorrhea. I strongly believe that the results that can be obtained from what I have in mind as a standardized treatment justify a complete change of opinion. (C. C. Sherwood.)

I believe the results of treatment are such as to justify a more optimistic attitude on the part of the general practitioner. (A. H. Merritt.)

Pyorrhea can be cured and is being cured daily in many offices. To question this is the result of being uninformed or misinformed. (Grace Rogers Spalding.)

These answers selected from general practitioners and specialists prove that we still have a divided house on the question. The specialist is positive that he cures the cases; but some of the general practitioners have still to be convinced. Believing this was the case, and that a publication of the newer thought might bring about a more harmonious conception of the postoperative treatment with its end-results, I shall now correlate the answers to question 2.

Question 2.—To produce the best end-results, do you think increased responsibility should be thrown on the patient, or are better methods of operation and treatment necessary?

Replies.—Increased responsibility on the patient. We stress it to the very limit. (C. C. Sherwood.)

The home care is absolutely necessary. (W. J. Charters.)

Increased responsibility thrown on the patient. (A. F. James.)

Permanent results depend entirely on the mouth hygiene and gingival massage practiced by the patient during and after treatment. (Benjamin Tishler.)

Increased responsibility should also be thrown on the dentist, because, in ninety-five cases out of every 100 treated, the operator has omitted not only the fundamental but also the

cardinal principles of restorative dentistry. (P. H. Edmand.)

Improve the methods of treatment. (Gillette Hayden.)

It is the duty of every dentist to investigate and try out any new methods which appear to have merits.

Responsibility on patient if he has had competent treatment. (A. F. James.)

No better methods of operation and treatment than we are now using at the present time. (A. J. McDonagh.)

Even with poor methods of treatment, an intelligent patient, willing to cooperate, can accomplish wonders. (Grace Rogers Spalding.)

Each (patient and dentist) is responsible for his individual share. Present methods of thorough and careful scaling and polishing are satisfactory. (Gillette Hayden.)

The responsibility for continued health remains with the patient. (Julian Smith.)

The home care of the mouth is of the utmost importance. (M. M. Bettman.)

The average patient does not do his share. (Celia Rich.)

The original treatment as ordinarily administered by the dentist is urgently in need of being vastly improved. (F. S. McKay.)

When the dental student is made to realize the necessity for studying the odontium and the periodontium fifty-fifty, then, and then only, can a real commencement be made to train a general practitioner who is capable of dealing adequately with the issues of daily practice. (E. M. Quinby.)

Question 3.—As nearly as possible call to mind some real, plain cases of pyorrhea treated about five years ago which you have recently seen. Describe the case as to looks of gums and loss of teeth since treatment, bearing on health of patient and your opinion of the end-results as presented.

Replies.—Almost daily, we see in our office patients treated for pyorrhea more than five years ago, whose mouths are still in good condition, who have lost no teeth in that time and whose general health has been during this time and still is much better than when the treatment was begun. (T. F. Bates.)

I telephoned ten patients for whom I have operated on the complete mouth over eight years ago to come in. Eight of them had no recurrence of trouble, and the other two had one and two pockets, respectively. This I attribute to faulty technic on my part. (E. M. Quinby.)

Teeth are not lost in five years after treatment if good judgment was used at the time of treatment in condemning hopeless teeth. (Grace Rogers Spalding.)

One always calls to mind cases in which the most pleasing results were obtained. (Gillette Hayden.)

And so the whole list of replies were filled with favorable reports of cases standing in almost perfect condition, with little or no subsequent treatment from operators. However, all were emphatic with the statement that frequent prophylactic treatments were necessary to keep the cases in proper condition.

Question 4.—When do you consider the ordinary case of pyorrhea satisfactorily treated and what constitutes a cure?

There seemed to be no hedging on the belief and observation of the men

on this question. From the outstanding answers, the following extracts were culled:

Replies.—When all pockets are obliterated, by scaling and curetting, thus getting a reattachment; or by cutting away the tissues forming the pockets where it is impossible to get a reattachment. (Gillette Hayden.)

When I have restored occlusion, when cervical hemorrhage stops and tissue becomes acclimated to the intensive brushing. (C. C. Sherwood.)

Effort is made to make the gum recede by the aid of the toothbrush and gum stimulator, but in advanced cases the gum is removed to the depth of the pocket. This is very important. (E. M. Quinby.)

In severe cases that were treated surgically by resecting the gum tissue to eliminate pockets, the end-result after five years has been vastly better than where the treatment was confined to scaling and curetting. (H. M. Garvin.)

Gums must be of good tone and color and not bleed when massaged or when teeth are brushed. There must be no pus present which can be forced from pockets or subgingival space. There must be complete mouth and tooth comfort and an excellent state of cleanliness. (Grace Rogers Spalding.)

A cure does not mean restoration to original conditions, but restoration to health. (A. H. Merritt.)

Ideal conditions are hardly possible where so many influences are continually present, ready to start destructive processes; but color and texture of gingiva, "tissue tone," together with partial or complete reattachment and lessening the depth of the pocket with arrestment of all exudation from gingival border would constitute, to my mind, our official responsibility. (Julian Smith.)

I am satisfied when teeth are restored to function and comfort and chemical evidence of infection has been eliminated as shown by color and "consistency" of the gingiva, disappearance or decided reduction in the depth of the pockets, with tightening of the soft tissue about roots and absence of bleeding on passing a blunt instrument into this subgingival place. (Celia Rich.)

I consider the fact of retaining the majority of dental units might constitute a satisfactory result. I would call it preventive or "alleviative" treatment rather than cure. I am skeptical about "cures." I regard the use of the term cure as applied to pyorrhea as unsatisfactory and possibly misleading. I prefer to consider it as an arrest of destruction. (E. M. Quinby.)

Question 5.—Have you witnessed any health restoration traceable directly to treatment of pyorrhea? Have you seen any who should have had their teeth extracted instead of treated? Describe.

The answers to this question were given at such length that a separate paper could be written on the subject. We all agree that a diseased mouth should be treated whether cures are effected for other ailments of the patient or not. Although the majority quoted miraculous health restorations, there were five men who were in doubt as to such a result, while three had not been able to cure other diseases by periodontic operations. (F. S. McKay, A. H. Merritt, D. F. Mosher.)

One periodontist said: "None that I could be certain were directly the result of treatment." (A. H. Merritt.) But the exodontists were just as sure as the majority of periodontists men-

tioned above that they had cured many ailments by the extraction of pyorrheic teeth even after such treatment.

Remembering our notation to the exodontist, we must give careful consideration to his views. Nearly all of them view our work thus. "Cases continually come to the exodontist after unsuccessful treatment for years. Most of these were doomed in the beginning, but the slogan, 'Don't give up your teeth,' encouraged the patient to put up with pain, pus and expense in the effort to keep them. My impression after years of experience is that so much good could be done the public if the effort were made to encourage patients in preventing the ravages of periodontoclasia instead of wasting so much time endeavoring to do that which proves a failure." (H. M. Davis.)

Question 6. — What percentage of patients after dismissal had to have additional operative procedure?

In the answers to this question, I find quite a variance of opinion. From each side of the question, we give some of the outstanding answers.

Replies. — The percentage was so large I dare not guess. (C. C. Sherwood.)

Probably five per cent. Seventy-five per cent. (A. S. Tuller, R. Y. Jones.)

I presume there are a goodly number of recurrences to my discredit. (Gillette Hayden.)

In a very large percentage of patients, unless rigid oral hygiene is obtained and resistance kept high, additional operative procedure is necessary. (W. H. Scherer.)

All cases require follow-up and some operative procedure from time to time. (J. S. Hoffman, C. H. Schott.)

The majority. (W. A. Jaquette.)

(I agree with the answer just given. It is with great satisfaction that I find others having no such difficulty. However, it will be noticed that these operators are prone to shift the responsibility to the patient.)

I have never seen a patient have a complete relapse after proper treatment, within six months. (Gillette Hayden.)

Lack of cooperation. They have failed to do effectively what we taught them. (C. C. Sherwood.)

Presuming that such a thing ever did happen, I would say you should have had a different dentist to treat your case. The one who operated was a failure. (A. J. McDonagh.)

It is because the operator has failed to get the cooperation of the patient, in which case he should try again to obtain that cooperation, or else there is some serious systemic trouble that should be investigated. (H. M. Garvin.)

He should know his limitations and not attempt to save teeth which are beyond his skill, unless he is willing to send the patient to a more skillful operator. The percentage is growing less each year as I improve my judgment and skill. (Grace Rogers Spalding.)

Question 7.—If a patient returns in six months with a complete relapse, what do you say to him and what is your method of handling?

Replies.—Request the patient to have a complete physical diagnosis. Can't see a "complete relapse" in six months. (Gillette Hayden, Thaddeus P. Hyatt.)

I do not see patients who return at end of six months with a complete relapse. Some have not done so well as they should, and in that case I try to find the cause and eliminate it. (A. H. Merritt.)

I have never had a complete relapse. (P. H. Edmand, Maxwell Dixon.)

Relapse only occurs when the patient does not follow directions. I would refuse to again handle his case. (T. P. Hinman, Benjamin Tishler.)

Supposing the original treatment to have been adequate and thoroughly performed, any relapse could only indicate that the patient's own daily care had been careless and the patient should be told just this. A patient of this description will require more instrumentation at the various periodic visits and repeated instructions and exhortations to induce a daily care that shall be more adequate. (F. S. McKay.)

Question 8. — Name your greatest factor entering into a satisfactory treatment.

Replies. — Correct instrumentation. (T. F. Bates, W. J. Charters, Maxwell Dixon, F. S. McKay, T. P. Hinman, C. C. Sherwood.)

Effective mouth hygiene. (C. C. Sherwood, W. J. Charters, Julian Smith, W. H. Scherer.)

Correct and complete diagnosis and prognosis. (Grace Rogers Spalding, D. F. Mosher.)

A correct technic. (A. H. Merritt.)

Enthusiastic cooperation from the patient. (A. S. Tuller, Thaddeus P. Hyatt.)

Correction of traumatic occlusion. (M. M. Bettman.)

My ability as a teacher. (A. F. James.)

My patient must satisfy us that he not only understands what we are talking about but must execute it to our satisfaction. (C. C. Sherwood.)

A pyorrhea patient should never be dismissed. The same negligence that started the pyorrhea in the first place would cause its recurrence as it did originally. (Frank Skinner.)

There is no "greatest factor." All of equal importance. (Benjamin Tishler.)

While it was my intention to avoid the use of quotations from any previously printed book or paper, I deem it wise to make two notable exceptions. The first is in reference to a new bulletin sent us by Harold Keith Box as his answer to the questionnaire as he was leaving for his vacation. This bulletin is entitled, "Treatment of the Periodontal Pocket," just published by the University of Toronto Press. It is such an excellent contribution to our literature that rather than make any quotations, it is suggested that everyone who wishes some of the latest findings should immediately make application for one of these bulletins.

The other exception is to mention the work being done by the California Stomatological Research Group, for which F. V. Simonton is a spokesman. These reports should also be studied by all who wish to succeed in the treatment of diseased gums.

The response to this questionnaire was very generous. Some answers covered six pages of typewritten matter. One dentist wrote that he had rewritten his answers several times to be sure that they were correct. To all these, we extend our thanks. In a short paper like this it was impossible to even give short quotations from all of them. However, these papers have been carefully preserved, and this valuable material will be used for some future paper.

The answers selected and read to you are from frank, well-worded opinions.

From these many condensed expressions can be gained much satisfaction and food for practical application.

To be sure, we are not yet agreed on the etiology of many gingival diseases. We are not agreed as to whether "In severe cases that were treated surgically by resecting the gum tissue to eliminate pockets, the end-results after five years have been vastly better than where the treatment was confined to scaling and curetting." Many were in accord with the dentist from Chicago who says, "If by operative procedures you mean gum resection, I have never, to my knowledge, had a patient who required it."

CONCLUSIONS

1. Notwithstanding the divergence of opinion on operative procedure, the evidence is overwhelmingly positive that the dental profession is successful in the treatment of pyorrhea conditions, and year by year we are improving end-results.

2. We are now of one accord with the great idea of increased skill for diagnosis, also the necessity for raising tissue resistance by gum stimulation as "gum culture," which must become a fixed habit by the patient. When this cooperation of the patient has been gained, we can produce satisfactory end-results.

803 Atlanta National Bank Building.

BACTERIOLOGIC STUDY OF NORMAL VITAL TEETH*

By LOUIE T. AUSTIN, D. D. S., and THOMAS J. COOK, D. D. S., Rochester, Minn.

THIS study was undertaken for two purposes: to secure a control for the large number of pulpless teeth cultured at The Mayo Clinic, and to determine the correctness of the opinion that a large percentage of normal vital teeth yield cultures of streptococci.

Henrici and Hartzell,[1] in 1919, cultured twenty-two normal vital teeth and all cultures were negative. In their cultures of vital teeth affected with pyorrhea, 42 per cent were positive; of those affected with caries, 43 per cent were positive; and of those affected with both pyorrhea and caries, 46 per cent were positive.

CLINICAL MATERIAL

Specimens for bacteriologic study were obtained from the apices of normal vital teeth. These teeth were removed usually because there were a scattered few and a full denture was advised. In cases in which a number of pyorrheal or pulpless teeth were being removed and one or two normal vital teeth were present, a full denture was advised. In such cases, the teeth to be cultured were treated with the usual precaution and removed first. Not more than two teeth were cultured in any one case.

TECHNIC

The patient is placed on the operating table and the same precautions are used

*From the Section on Dental Surgery, The Mayo Clinic, and the Division of Experimental Bacteriology, The Mayo Foundation.

1. Henrici, A. T., and Hartzell, T. B.: Bacteriology of Vital Pulps, J. Dent. Res., 1: 419-422, 1919.

as in other surgical procedures concerning sterile towels, gloves, gowns, instruments and so forth. The patient's head and chest are covered with sterile towels and the operative field is completely walled off with sterile gauze. The area about the tooth that is to be removed is dried with a sterile swab. It is then painted with 3 per cent iodin, care being taken to have it penetrate well into the gingival margin about the tooth. Seventy-five per cent alcohol is then applied to the area and it is dried with a sterile swab. The area is then tested for sterility by swabbing the field with a sterile swab and placing the swab in a tube of glucose-brain broth, which serves as a control. It is then placed in the incubator with the other cultures, and if a growth is obtained, the operative field and cultures are considered contaminated and the cultures are discarded.

The tooth is then extracted, and while it is still held in the extraction forceps, the apex is severed with special cutting forceps, and dropped into a screw-top tube containing about 1 c.c. gelatin-Locke solution and sand. The tube is immediately sealed, taken to the bacteriologic laboratory, and placed on a shaking machine for ten minutes, so as to macerate as much as possible the tissue about the apex of the severed root ends. This shaken material is then transferred by means of pipets to two tubes of glucose-brain broth and one tube of glucose-brain-agar as well as being streaked on a blood-agar plate. The apex is placed in one of the tubes containing glucose-brain broth. Glucose-brain broth and glucose-brain-agar are used in this study because of their nutritive qualities, which are especially favorable for the growth of organisms encountered in infections about the oral cavity. The long tubes of brain broth provide every degree of oxygen tension; the brain at the bottom renders it anaerobic, while the top may be favorable for aerobic growth.

RESULTS OF CULTURES FROM 100 VITAL AND 100 PULPLESS TEETH

Teeth Cultured	Number	Cultures in Glucose-Brain Broth		Cultures in Glucose-Brain-Agar				
					Colonies			
		Positive	Negative	No Growth	0 to 20	20 to 50	50 to 100	Over 100
Vital	100	4	96	96	3	.....	1	.....
Pulpless (controls)	100	89	11	11	2	9	3	75
Roentgenologically negative	50	84	16	16	4	8	2	70
Roentgenologically positive	50	94	6	6	.....	10	4	80

Of the 100 cultures from normal vital teeth which were free from contamination, 4 per cent showed positive growths of streptococci in glucose-brain broth and 96 per cent of the cultures were negative (tabulation). Of the 4 per cent that gave positive cultures, 3 per cent showed less than twenty colonies in glucose-brain-agar, and 1 per cent showed approximately 100 colonies. These cultures were incubated for as long as two weeks before they were discarded. A possible explanation for the 4 per cent of positive cultures may be that some of these cultures were obtained from patients who were not only harboring a large number of infected teeth, some of which were immediately adjacent to the vital tooth cultured, but

were also suffering from infective diseases.

In the pulpless group, which was used as a control, it was interesting to note that there was not a great difference in the percentage growths of streptococci in the series of roentgenologically negative teeth cultured and that of the roentgenologically positive group.

In the roentgenologically negative group, the teeth cultured yielded *Streptococcus viridans* in 84 per cent of the cultures, and 16 per cent were negative in glucose-brain broth. In brain-agar, 4 per cent showed up to twenty colonies; 8 per cent, from twenty to fifty; 2 per cent, from fifty to 100, and 70 per cent, from 100 to countless colonies. In this series of fifty roentgenologically negative pulpless teeth, there were four root canals that were one-quarter filled, twelve that were one-half filled, twenty-four that were three-quarters filled and ten that gave evidence of having a complete filling.

In the roentgenologically positive group of pulpless teeth, positive cultures of *Streptococcus viridans* were found in 94 per cent of the cultures in glucose-brain broth, and 6 per cent remained negative. In glucose-brain-agar, 6 per cent did not give a growth; 10 per cent yielded from twenty to fifty colonies; 4 per cent, from fifty to 100 colonies, and 80 per cent from 100 to countless colonies. In this series, five root canals did not have fillings, nine were one-quarter filled, twelve were one-half filled, eighteen were three-quarters filled and six had complete fillings.

Of the 100 pulpless teeth, including the roentgenologically negative and the roentgenologically positive groups, 89 per cent gave a positive growth of *Streptococcus viridans* and 11 per cent did not give a growth. Of this series, 75 per cent yielded more than 100 colonies in agar, which indicated that considerable infection was present in most of the cases.

ALVEOLECTOMY*

By ROY R. RALSTON, D. D. S., Omaha, Nebr.

THE present method of extraction of teeth is unscientific. The reason for the extraction of teeth is loss of function or an existing pathologic condition. It is a well known surgical fact that blind curettement is a very unsatisfactory procedure.

The term "alveolectomy" was supplied by the late D. E. Jenkins of the University of Omaha. This operation, which was first performed by William L. Shearer of Omaha, in 1905, was formerly called external alveolectomy. It was the opinion of Dr. Jenkins, in the beginning, that only the external plate of the alveolar process was removed. This was not the case. The mucoperiosteum was reflected buccally and lingually, and all diseased areas were thoroughly removed and the stress bearing areas of the ridge arched. When this was brought to the attention of Dr. Jenkins, he de-

*Read before the American Society of Oral Surgeons and Exodontists, Minneapolis, Minn., Aug. 18, 1928.

cided that the term "external" should be omitted.

It has been thought by some that Dr. Shearer removed the interseptal alveolar process. This is not true. No doubt, some have received this impression from diagrammatic drawings which he had made during his early work along this line, these being the best drawings that he could obtain at that time. No one, as a matter of courtesy to an author, should form conclusions and make destructive criticism from diagrammatic drawings.

In 1906, Dr. Shearer read a paper before the Tri-City Dental Society, presenting the subject of alveolectomy. He also gave some diagrammatic drawings of his work on a scrap of paper. Naturally, this operation has been modified and improved on by Dr. Shearer in the course of twenty-three years.

It might seem that I am going into too much detail, but the flap operation, alveolectomy and partial alveolectomy, belongs to and was given the profession by none other than Dr. Shearer.

Fig. 1 (Case 1).—Cast of lower jaw after extraction of teeth and reflection of mucoperiosteum lingually and buccally on right mandible. The cast to the right was made immediately after completion of alveolectomy.

Primarily, this operation was intended to remove protuberances of the alveolar process of the maxilla in order that dentures could be made more satisfactorily. On reflecting the mucoperiosteum, Dr. Shearer was astonished to find so great an amount of necrosis of the bone and soft tissue. Whereupon, a general surgeon, B. B. Davis, of Omaha, was called in for consultation. Dr. Davis advised the removal of all pathologic areas, one of the cardinal principles of surgery.

Briefly, as regards the technic of this work, we shall presume that a hospital case or one to be admitted is to be dealt with. The patient may or may not have had a complete physical examination, including urinalysis, a differential blood count and Wassermann test, this having been left to the judgment of the operator. In a hospital case, the previous meal is omitted, a soap suds enema is given, and, from one-half to one hour before operation, those alkaloids are given which, in

my judgment, may be indicated. The area of operation is then blocked with 1 per cent solution of procain, freshly prepared. The extent of the blocking depends on whether the operator is going to perform a complete alveolectomy of one or both jaws, or only a partial alveolectomy. An operation on both jaws can be done as safely as a partial alveolectomy for one tooth, in most cases. This will depend largely on the ability of the operator. Naturally, there are a small percentage of patients with whom one would be more cautious as to the amount of surgery advisable. In our hands, local anesthesia is by far the best. It is less hazardous, and we are able to work over a longer period of time with the help of the patient; consequently, carrying out a definite technic.

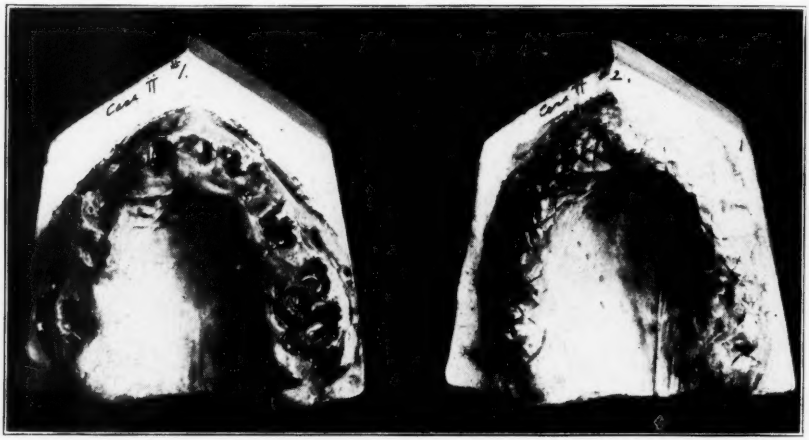

Fig. 2 (Case 2).—Casts of upper jaw. Left: Cast made immediately after extraction of teeth, with reflection of mucoperiosteum buccally and labially. Right: Cast made after alveolectomy.

We shall now consider the procedure of a complete alveolectomy of the upper jaw where infection extends to the floor of the maxillary sinus. An incision is made along the crest of the alveolar ridge from tuberosity to tuberosity. The mucoperiosteum is reflected well back, both buccally and lingually, either before or after the removal of the teeth, this depending on the judgment and wishes of the operator. In case of difficult extraction, roots, residual or otherwise, may be taken out after the flap is laid back. An ocular observation of one's work always makes it easier. Next, the edges of the mucoperiosteum are trimmed with scissors to remove all necrotic tissue and irregularities. (This will promote a primary union of the flaps when they are laid back in position and sutured at the close of the operation.) Next, all necrotic areas of the bone and areas of condensing osteitis are removed with large and small Shearer rongeur forceps, also with curettes, which must be kept very sharp.

The thin buccal and labial plates of bone over the roots are removed to the ends of the roots in most cases, in order to gain access to the apical areas. If this is not done, too often the thin buccal

plate over the tooth will give way, which causes much sloughing and pain, and spiculae of bone gradually come through the mucoperiosteum. The interseptal process is left and rounded, if in a healthy condition. Good roentgenograms are a great help in locating residual areas, although they do not, by any means, tell the whole story. One might say, in passing, that the correct interpretation of the roentgenogram is another important step to be considered in the handling of the case, although one cannot put too much dependence on the films.

below the posterior palatine canal, a bony prominence. This may vary in size and shape from a sharp spine one-eighth inch long to an osteoma the size of an ordinary kidney bean. This should be removed with a rongeur forceps and smoothed with a large curette or file. After the buccal and lingual maxillae are rounded and then smoothed, the mucoperiosteal flaps are brought back into position and sutured with horsehair. One tie is made at the medial line, and the continuous sutures are whipped over and over in one direction, continuing to the

Fig. 3 (Case 3).—Upper jaw. Left: Cast showing reflection of mucoperiosteum on right side. Right: Completed alveolectomy.

Necrotic areas in the region of the floor of the maxillary sinus are encountered continually. These areas must be thoroughly removed and the mucous membrane of the maxillary sinus left intact, provided we are not contemplating a sinus operation. Again, the roentgen-ray is a guide, pointing out the floor of the maxillary sinus and the relation of the roots of the teeth.

It is a very common thing to find on the palatal side above the cemento-enamel junction of the upper third molars, just tuberosity and back. The same process is repeated on the other side. When this is done, we have one knot or tie at the medial line.

Practically the same procedure is carried out with the mandible. One matter pertaining to the mylohyoid ridge is very important. This ridge is prominent in some cases and must be removed with rongeur forceps and large, sharp curettes. This protuberance, if left, often cuts through the mucoperiosteum and gives no end of discomfort to the patient. It

often interferes with the proper fitting of an artificial denture in this particular area.

The use in the mouth of dressings and sponges wrung out of hot salt water is strongly advised during operation. On completion of these operations, hot magnesium sulphate packs are applied to the face for one hour. Hot irrigations of a physiologic solution of sodium chlorid, or 0.5 per cent compound solution of cresol, are used the following day with a 2-quart irrigating can, the heat being the most

models which were taken from the actual impressions of surgical work done in the University of Nebraska, College of Medicine, by me. These impressions were poured up in stone and colored by my brother, O. A. Ralston of Ainsworth, Nebr. A detailed description will be given as to the manner in which he made these original models.

The construction of casts of work in dental surgery, especially the operation known as alveolectomy, is not original with me, for these have been made in

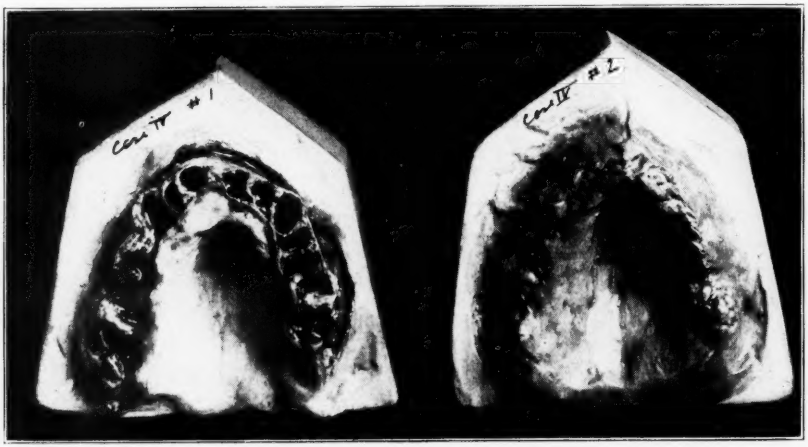

Fig. 4 (Case 4).—Upper jaw. Left: Reflection of mucoperiosteum showing alveolar process exactly as it appears after teeth are removed. Right: Completed alveolectomy.

important factor. These are used three times a day or oftener. The hot magnesium sulphate packs can be used several times a day to very good advantage, until the sutures are removed, four or five days later. In these cases, the mouth heals in three or four days with little or no febrile reaction. A slight rise in temperature the same day of operation is not uncommon, being due, no doubt, to protein absorption.

Slides have been made from colored plain plaster of completed cases of this work. There have been other models arranged by artists from carvings and paintings in hard soap. However, it was an original idea with me to endeavor to show the contrast, in actual casts, between simple extraction of the teeth and alveolectomy.

No one of whom I know has ever tried to take a series of impressions of the alveolar ridges immediately after extractions because of plaster being out of the

question and compound liable to infect the field of operation. The question was one of impression material, and after the compound was prepared aseptically and softened in hot water, it was an easy matter to take such an impression. Dr. Shearer took many impressions in his early work, but no one has presented this subject in the manner that I am trying to present it as far as I know.

Impressions were taken immediately after extraction to show the jagged and splinter-like alveolar processes so commonly left. Then, impressions were struct as true a record as a photograph of the exact conditions of each case that was cast rather than carvings or paintings which have been previously made.

The casts were thoroughly dried for a number of days and further dehydrated in alcohol for twenty-four hours, after which they were again dried of the alcohol and given a priming coat of linseed oil. The coloring was copied from the operation in oil paints as nearly as the artist's skill would permit. Here, I might add that the painting of the casts to imitate the colors in the operation de-

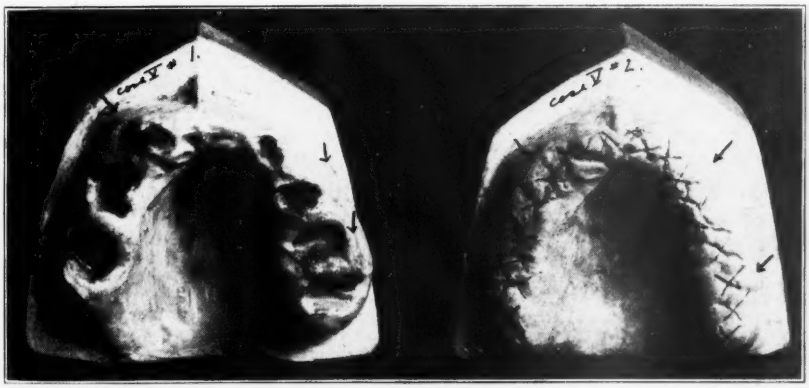

Fig. 5 (Case 5).—Upper jaw. Left: Cast made immediately after extraction of teeth. Right: Completed alveolectomy. Arrows point to areas where large dentigerous cysts were removed.

taken with the buccal and lingual mucoperiosteal flaps laid back; again with the surgery half completed, and in every case with the alveolectomy finished.

The impressions were poured in artificial stone with a 1-inch base included. This model was allowed the usual time for perfect setting of the stone material and then the base only was planed and sanded smooth. The casts of the patient's jaws were not touched with carving instruments, for it was my idea to conpended on the skill of the artist and the time he wished to spend on each model, as an unlimited amount of time can be spent to reproduce nature's delicate coloring of the tissues of the mouth.

The bases of the models are painted with aluminum paint, which dries quickly and leaves a fine surface. Lettering on the back of each model, giving the patient's name, address, and the date of operation, together with the number of

the clinical and hospital record, is done in India ink.

Over the whole model, three coats of clear varnish are added before the case is finished. Such casts, made of the hardest artificial stone and finished in oil paints, are practically indestructible and should last throughout all time.

These models are of great value to the oral surgeon in explaining to the layman as well as to the dental and medical professions the reasons for and benefits derived from alveolectomy.

The benefit derived by the patient is twofold. First and possibly most important, the cleaning up of foci of infection is accomplished. Secondly, the mouth is prepared for artificial dentures. These can be successfully made in two or three weeks after operation.

In the majority of cases, chronic infection of the maxillary sinuses which open into the mouth is almost invariably due to extraction of teeth and blind curettement. One could safely say that in less than 0.5 per cent of cases rupture of the membranes of the maxillary sinus is due to or accompanies the extraction of teeth. The mucous membrane of the maxillary sinus is a marvelous membrane. It is seldom broken unless at the hands of the dentist. A thorough training under a competent surgeon is the foundation for any surgical procedure.

In fairness to my brother, Dr. Ralston, and in appreciation of his assistance in presenting this work, a few words should be said. He made many trips of 300 miles from Ainsworth to the University hospital, where the work was being carried on, at his own expense, spending many days studying the work and taking down his colors at the time the operations were being made. In addition, he made all the models. Without his assistance, I could never have presented this work.

WHAT CONSTITUTES AN IDEAL PARTIAL DENTURE*

By HERMAN E. S. CHAYES, D.D.S., New York City

THE kind of partial denture which will permit the remaining teeth to express themselves to the correct degree so as to maintain form, function and nutrition and will stimulate the natural teeth which it is replacing in the exercise of the trinity mentioned constitutes an ideal partial denture.

*Read before the Section on Full Dental Prosthesis at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 21, 1928.

PROBLEM OF THE PARTIAL DENTURE AND ITS RATIONAL SOLUTION

Seventeen years ago, I brought down upon myself the wrath of the dental profession by writing and publishing a paper entitled "Empiricism in Bridgework." In this paper, which was followed by one from the pen of Hunter, of England, called "Septic Dentistry," I drew attention to the destructive influence of the then practiced art and sounded a note of warning to the mem-

bers of the profession, calling for a recasting of methods of practice.

During the seventeen years which have passed, a great change of thought and procedure has become manifest in our profession. Condemnation of my stand gradually became less vehement, yielding to tolerance and finally to acceptance on the part of a goodly number of thoughtful members of the profession of the methods advocated by me.

No one can go through gruelling years of criticism and opposition without in some way or other becoming scar-marked in the fray, and without becoming introspective and retrospective as to the causes for the apparently slow growth of the idea.

The profession of dentistry numbers about 120,000 men and women, most of them individuals well able to think. Grouped around these 120,000 individuals are probably 500,000 people employed in the industry directly or indirectly, busying themselves with production of things needed in the profession. Multiply these numbers by 5 and you obtain an idea of the number of living beings who are interdependently affected by what the profession thinks and how it acts.

Three million one hundred thousand people speak and they surely have a right to be heard.

Three million one hundred thousand people are asked to listen to something and surely they have a right to demand that it be told to them in such a way that they may see and understand its relevance —its importance, its verity—else why should they be asked to listen?

It must be that the message delivered by me seventeen years ago was inadequately expressed and whatever will herein be said must be more minutely set forth.

I therefore desire to so group the factors which should guide us in our work that an indisputable and clearly understandable sequence will enable us to acquire an indelible picture of the ultimates or principles we must understand and follow in our attempts to produce our proximates or effects, acceptable as concomitants of living structure.

It must be granted that it is the desire of all of us to see our patients happily healthy, and that we try to the best of our knowledge to adjust our services to their needs. It is largely our inability to visualize these needs which leads us into the wrong path and induces us to do things for them mechanically which can never be made to interplay correctly with their biologic demands, and yet our patients have biologic needs or they would not require our services.

It is well to say here that all work has a spiritual basis, which is only another way of stating that all tangible effects apprehended by and with our senses have their intangible origin or cause, the effects resulting from a slowing down or impeded motion of the particles which make up the cause.

If a picture were to pass before us at the rate of 40,000 impressions per minute, we would never become aware of its existence; slow it down to 35,000, a blur appears before our eyes; at 27,000 differentiation begins to be manifest, etc. The slower the motion, the clearer the detail.

Something must be said about the recently much heralded theory of the compensatory mechanism in the human body. It is an elaborate attempt on our part to justify our inability to restore various diseased parts of the human body to ease and usefulness, and it jars on our ears with the preposterousness of its reasoning and logic as advanced by its sponsors

in their hectic efforts to make out of the ludicrous theory an acceptable doctrine.

One need not question the candor of these proselytes of the new physiology relative to the trading of function between different organs in order to realize the stupendous error of their way. One may even grant that they feel themselves to be right, but one who thinks rationally will also, at a glance, perceive the flimsy basis upon which rests the very foundation of their entire pseudophysiology.

There is no such thing as compensatory dynamics in the economy of the animal or human kingdom or any of the kingdoms, in the true sense of the word. There is, however, an interdependent dynamicity which is quite different from a compensatory kind.

It is true that one kidney may be removed and the body fluid filtration process will be assumed by the remaining one, but at what expense, as to form, its own form and the form of its adjacent viscera! Is there any one in this audience who will venture to say that the changes occurring in such an organ are free from any possibility of pathologic consequences? Will any one say that it is not more likely to become pathologically involved because of its additional load? And if you will not say it about the kidney, why will you say it about a tooth or a few teeth when you overload them and inhibit or augment their mobility?

In the September, 1927, issue of THE JOURNAL are two papers on fixed bridgework. The arguments presented are all puerile and should by rights be ignored. One man makes the statement that while it is true that anterior teeth perform a different function from the posterior ones (and hence are activated to move in different directions), it is nevertheless, all right to unite such organs by means of a fixed bridge, because the whole of it will move any way. What childish contradictions are these, what immaturity of thought with which to fill the pages of a journal supposedly devoted to an art and to what pretends to be a science!

Now I know as you do that the best restoration made by human hands for the human mouth cannot equal in form or function the natural equipment of that mouth, but that knowledge gives none of us the right to ignore the well-being of any of the remaining teeth in the mouth when we make a restoration for it.

The fact that we know that, at its best, the artificial restoration is a crutch imposes on us the responsibility to so construct it that it will add to the livingness of the remaining teeth and add to the health of the soft structures rather than inhibit any of the parts in their expression.

I have no desire to even attempt to impose my thoughts on the subject on any one who may listen to what I have to say or who may subsequently read the contents of this paper. On the contrary, I would try to elicit your thoughts on this subject to bring out of the depth of your consciousness the state of your true feelings in the matter, so that we may reason together. Words alone will not do, no matter what the rhythm or syntax or composition may be. They will be meaningless sounds, unless they express a properly synthetized picture of the real state of things.

Our ethical principles carry the sheer pattern of our daily acts. The things which we do to our neighbor, the acts which we perform for or against the social structure in which we live, are all rooted in the less tangible soil of our ethical principles.

We cannot conceive of the process of thinking unless we, at the same time, con-

ceive of an instrument to think with, and each living sentient being possesses the ability to think to some degree at least.

Mind expresses itself in thought by way of the nervous system; and we may say mind is the source, the nervous system is the instrument and thought is the effect; hence, we may say mind is the essence of thought, or thought is the fabric we weave with mental thread—the sheer, invisible fabric in which is carried the pattern of our entire activity. Furthermore, thought is the essence of our action, conscious thought is behind every conscious act, subconscious thought behind every autonomic act.

Every deviation from perfect integration of all parts of the human body requires on our part an understanding of the language which the biology of the body uses in speaking of its hurts.

Pathology is only the symbol of infraction on the otherwise harmonious effect which, as a result of perfect integration of all organs which make up the human body, manifests itself in health expression; and it is when we, because of ignorance or indifference, fail to grasp the meaning of the symbols which appear on infraction of biologic integration that our efforts to establish repair result only in further infraction on the harmony of the organic unity of the body.

Not all particles of matter have the same place in the sun, reach the same place on the spiral or are equally successful in point of time or space or place in gathering experience. But even as our entire language is composed of the alphabet and all our geometry has its origin in a point in space, so all material things have a common origin.

We know that some may embellish their thoughts with words. We also know that some most often half murder their thoughts with words. Some will correctly solve the most intricate mathematical problem, and some will lose themselves hopelessly in the simplest one. Yet language has but twenty-six letters and mathematics but ten numbers. What is it then that makes the difference? In my opinion, it is the fact that most of us do not realize that letters and numbers are but symbols—externals, outsides, tangents—of the real, internals, the spheres. We fail to grasp the real meaning behind these things, and we accept the things themselves as the vitalizing, vivifying, spiritualizing verities which they symbolize. Truly, when we let Nature speak, it is as if the spirit of language were bearing its content, and when we attempt to speak for her, it seems as if our language at its best were but the stuttering words of a searching soul.

Dentistry, our work, has had its tremendous difficulties in its efforts to harmonize its expression with the biologic needs of the patient. It is an art too meager in experience to cope adequately in point of repair and prevention with the needs of the human dental apparatus. But that American dentistry has fought brilliantly to stem the tide of decay which at times threatened the very life of the nation, no one can justly deny. It would be easy to recall indefinitely names of men who gave their best physically and mentally in their efforts to build dentistry into an efficient means of protection for public health, most often without due recognition on the part of the people themselves; and when we in the profession shall have in the course of our evolution awakened sufficiently to grasp the principle of life and motion as manifest in the human mouth which needs our attention in the matter of reconstruction or repair, we will be impelled to cease tinkering and pause to think, and

American dentistry will reach the goal it is headed for—a great Art, a great Science, of untold benefits to Mankind, the practice of which will dignify its adherents and will consecrate them as true servants of mankind.

With these introductory remarks held clearly in our minds, may I now be permitted to make this deductive statement in the hope that you will be in full accord with its truth. A patient who presents to us a dental problem to be solved is no different from a patient who presents to a thoroughly versed surgeon a medicosurgical problem to be solved. In both instances, the problem will probably have to be solved by mechanical means or interference, and in both instances, whatever the result of the means used, they will have to be made to interplay correctly with all the other functioning organs of the patient. This being the case, a dental problem, in order to be correctly solved, so that the resulting effort may be acceptable to the patient's economy from every point of view, will involve an understanding and appreciation of the normal or harmonious condition of the general organism on the part of the dentist.

Most of the cases which present themselves to us for attention may be grouped as either congenital or acquired defects, and under the name of acquired defects, we may range anything from accident, decay and improperly executed dental work, and in an examination of such mouths, assiduous care must be used to group every factor present so that we may, after a careful examination of the case, which would involve physical conditions, habits, the condition of the environmental tissue, the integration of the teeth present, the muscular equipment of the case affecting the dynamic phases, the circulatory and neural equipment of the patient and all the foregoing factors, determine the plan for the case. We must have a thorough knowledge of the intensity of the stress to which the teeth present are subjected, and the direction in which these stresses would tend to move them. If no tooth is missing, it will be necessary for us to select, as the tooth to begin our restoration with, one which has, in spite of accident or decay, lost the least of its anatomic form, and the reason for that is that the less of its structure there is missing, the less error we can commit in restoring it to normal; and after this one tooth has been restored, it can act as a guide to the restoration of the one immediately distal to it, the one immediately mesial to it and the one on the opposite jaw with which it interplays in occlusal relation.

The means to the end are made up of perfect interplay between the conception of the needs of the case, the plan which we evolve and the instruments and materials at hand for supplying these needs. It must be conceded that better work can be done with such tools and instruments as more readily lend themselves to correct manipulation in our hands.

The factors in the evolution of the case are, first, the mathematical factor which appears when we clearly understand that the human being like the universe is an aggregation of numbers in motion, and form is an essential complement of matter, that is the definite form; that each organ or part of organ in the body has its essential definite form, and in the reconstruction of any of the things, we must not deviate from this form evolved through millions of years of evolution.

Then, there is the biologic factor which appears when we clearly understand that such numbers in motion bring about macroscopic aggregations which

are manifest as living entities, possessing neural and nutritional needs.

Then, there is the physiologic factor which appears with the development of the former and is expressed as a necessary interplay of the foregoing and following factors with the least or no interference with one another.

Then, there is the anatomic factor which appears on the final manifestation of all the former factors as the final effort as a result of all former work; and the hygienic factor which results from the association of perfect form as subjected to functional stresses by properly integrated forces as resultants of all factors heretofore enumerated. Only integration of all these factors named can be relied on to result in a piece of restorative work for the human mouth wholly acceptable as a complement to whatever organs may have been present when the patient presented himself to us.

In serving our patients, who for some cause or other have lost some of their teeth, shall we strive to so supply these missing teeth as to bring about a sense of perfect comfort in the patient, or shall we disregard the foregoing attribute and look only to perfect efficiency? Or shall the latter attribute be tempered with the need for esthetics?

It will be difficult to find any one in this audience, or for that matter, in any other dental audience, who will volunteer to prescribe specifically any one particular attribute as the important one in this instance, and the reason is perhaps to be found in the fact that form, function and nutrition make up the great trinity of the source of well-being of all organs of the body. Form, function and nutrition: to be at all, a thing must have form, but it acquires this only through, first, a general and, finally, a specialized function, and it cannot maintain that unless it obtains nutrition, and it cannot obtain nutrition unless it has function, and it cannot have function without acquiring form.

The sum of all life is expressed in action, in motion, in change; in definite precise action, in definite precise motion within given orbits, in predestined direction, in definite progressive mutation. There is no haphazardness in the universal scheme of things. There is no luck, no chance, in the universal law of growth; there is only cause and effect.

If we bear in mind what we have just heard, we will realize that each organ in the human body has neural and functional needs, both of which can be taken care of only when we maintain a quantitatively and qualitatively correct circulation in these organs, and in order to maintain that, we must at no time either inhibit or augment either in degree or direction the motion of any organ in the human body; and this certainly applies to the mouth and its contents, because, as I have said to you before, the movements of the natural teeth situated in the natural environment of the human mouth are determined by the interrelationship of all the teeth and the stresses to which they are subjected. The orbit of their motion is predestined so that, during their excursions, they will, by activating the tissues in which they sit, supply these and themselves with the nutrient elements necessary for the maintenance of their integrity. Please bear in mind that nutrition and function are the reciprocal dynamic phenomena of all tissues of all organs, and any reparative or reconstructive work done in and on any part of the oral cavity or its contents must be done with the maxim or principle in view that neither of these, that is, nutrition and function, must in any way be interfered with.

It is now definitely known that health *en masse* depends entirely on a properly balanced circulation. The proper play of both the cerebrospinal and the sympathetic nervous system depends entirely on a properly balanced circulation, and, conversely, a properly balanced circulation is greatly dependent on a smoothly working sympathetic nervous system. I have also said to you before that the processes of digestion, assimilation and nutrition are all under the control of the involuntary or sympathetic nervous system. The interdependence of all these phenomena is clear; it is a process of interrelated dynamics, the activity of one depending on the activity of the other or the action of one evoking a corresponding reaction on the other. Briefly, we must have good thoughts, we must have proper food, which, converted into good blood, must be sent racing through the proper channels to feed all the tissues.

When the red blood, in traversing its field of travel, reaches the vessels where transudation is possible, the cells of the tissues containing these attenuated vessels assert their needs, and by a process of selective chemicophysiologic affinity (or attraction) abstract the materials necessary for them from the mass of liquid traversing these vessels, and the liquid moves on to the next station, as it were.

The heart, as the great central pump, charged with the task of the initial impulse to send the blood through all channels, calls on the arteries, arterioles and the veins by virtue of muscular movement, to assist rhythmically in this task.

Organs at rest need less food than organs at work; hence, the rhythmic function of any organ induces a corresponding rhythmicity of action in the blood vessels, and thus the additional amount of necessary nutrient element is supplied.

You need thought to make money; you need money to buy food; you need food to make blood; you need blood to maintain function; you need function to maintain health; you need health to have thoughts.

We come down to the old mystic sentence that our blood is ourselves in solution, and since Nature creates and maintains, she must, as a logical corrolary, be able to cure, and she does this by way of an unfailing supply of a well-balanced circulation unless interfered with by outside influences.

It should be manifest to all thinking people, and more so to dentists, that, in the exercise of their function, different teeth move in different directions and that these movements conform in rhythmicity and degree to the demand of the vascular structures which surround them so as to activate or cause the supplying of the need of both teeth and surrounding tissues for an increase of nutrient elements. If two or three teeth are supplied in a manner disregarding the axiomatic truths offered above, the mobility of the rest of the teeth is either inhibited or augmented or altered in direction, and the waves of motion during function are altered in frequency, rhythm and direction. The small vessels in the tissues surrounding these teeth are there loaded with all the things which the tissues and the teeth need for sustenance; but the power of the cells in these tissues and teeth to abstract these materials is lost by desynchronization. The transuding vessels, trying, nevertheless, to do their part, leave a quantity of material there, the tissues and teeth cannot take it up, and we now have a condition of stagnation or morbidity: a quantity of organic material, the component particles of which are vibrating in rhythm foreign to the use

of the tissues and teeth it was intended for, with the result that it becomes a welcome pabulum or food for any so-called bacteria always present in us, with us and around us; as, shall we say, the all too prevalent sporadic remnants of past material life.

The partial denture held in position by means of clasps is no innovation in prostheses.

In one form or other, it has been in use for many decades and, like the fixed bridge, it has gone through many incarnations. In its original form of flat broad wrought clasps indiscriminately grasping the abutment teeth, it was discarded many years ago, its place being taken by the Bonwill type of clasp of round or half round wire with its occlusal rest.

The casting process and metallurgic researches of some of the gold refining houses made it possible to more conveniently impose more destructive effects on the abutment teeth, when the cast clasp was introduced.

Thus, two good discoveries were combined to yield further ill for the human mouth, and as far as the clasp denture is concerned, I feel justified in stating that the blackest page in dental prosthesis is being written by the votaries of the one piece casting.

One needs but read the many advertisements of the different laboratories holding themselves out as certified technicians of the process in order to obtain the evidence needed for the condemnation of the process. Such phrases as "hear it click into place, hear it snap into position, feel its grip and its firm seat," etc., clearly bring to light the woeful ignorance as to the biologic needs of the mouth calling for a restoration.

The best that can be said for the clasp denture, no matter what form it takes, is that, because of its simplicity of construction and inexpensiveness of material employed, it lends itself readily as a restoration for poor people unable to pay a decent fee for the right kind of work. It is not impossible to conceive and execute a clasp partial denture which would be fairly acceptable to the human mouth as a substitute for teeth which have been lost, provided the following requirements are met:

1. The clasp would have to be movable in the partial denture to just a sufficient degree to release the abutments from stress during mastication and no more.

2. Buccal or labial and lingual or palatal portions or horns of the clasps would have to exercise precisely the same amount of tension against the abutment tooth, lest the partial denture assume the function of an orthodontic appliance, which, in fact, all of them are.

3. No part of the frictional element should ever come in contact with unprotected enamel surfaces of the abutment.

4. A sufficient quantity of the protecting element must be removed so that, when the clasp is in position, no appreciable change in the form of the abutment has been brought about.

I submit to this audience that the foregoing are the sane requirements. Not one man who has studied carefully the normal mouth and wishes to minister to one requiring attention can honestly deny the sanity of these requirements. But in order to meet them in full in the construction of clasp dentures, this part of prostheses ceases to be simple and cheap.

By a lavish use of printer's ink in colored pictures, by an unscrupulous appeal to the basest of human traits (namely, greed), by insistent and persistent buffoon methods of barnstorming instructions, many gullible dentists

have been induced to place assembled cast clasp and one piece cast clasp dentures into many an unfortunate patient's mouth, without regard to the above named requirements, and many perfectly good teeth have been sent to an untimely grave, regulated into irregularity, supported into oblivion, bridged into Hades, and were that all, one could condone these acts as one condones a storm, an earthquake, a typhoon, as a temporary destructive explosion of nature's force, deflected from the normal path of expression by some obscure interference.

But judged by what I have previously told you, we are bound to consider the sequelae: Teeth are never abused without abusing the environmental tissues, and the local injury becomes a constitutional hurt.

The gross structure of the body is not so gross but 0.1 mm. counts, 0.01 counts, and everything in the body has its definite interdependent place, its definite interdependent orbit of motion; in short its form, its function, its nutrition.

It is true that the deleterious effects of clasps on human dentures are not immediately apparent and that to some they never become apparent; but the effects are there nevertheless. In different cases, the effects manifest themselves differently. In some, we find decalcified teeth from the simple pitting to the destruction of the entire enamel surface. In others, the environmental tissue becomes engorged, inflamed to the point of suppuration. In still others, teeth are moved entirely out of alinement. We ignore most often the signs we will not see; but just as often, these signs escape us through our ignorance. Many marked changes in people's dispositions are brought about by clasp dentures.

There are few here who would evaluate a beautiful sunset in exactly the same way. Some of us will distinguish three or four different colors blended into the picture; some of us will distinguish a dozen hues of one color. Some will see in the most divine piece of literature nothing but an aggregation of letters, but others will know its contents for what it is.

No amount of denial, no material reasons, economic or otherwise, no biblical quotation, no sophistry, will overcome the one biologic fact that man has evolved from helpless inefficiency to the present type with a set of thirty-two teeth, each sitting within its own socket upon a resilient cushion and resiliently joined to its surrounding structure, thus enjoying its own particular excursions in function.

You know what happens to the musculature of a fractured arm in splints and held in a sling during the period of repair, what may happen to a leg in the same circumstances, or to the thorax where the ribs have fractured and the patient has been strapped up, the mobility of the organs being limited within the thorax and the muscles on it; and when I speak of muscles, I refer not only to the striated muscles, the muscles of the external parts of the body, but also to the fine supple unstriated muscles of the viscera, the heart, the lungs, the entire circulatory system and the intestines. No one with any knowledge of physiology will doubt that permanent interference with motion in the proper direction of any of the parts named will induce an inhibition of function, and that inhibition of function will impair organic integrity. If any of you have any doubt about it, place one of your hands or arms in a sling while away on your vacation, then remove the splint after a period of a few weeks and note the lameness of the member and its puny appear-

ance as compared with the one of the opposite hand. It will convince you that organic integrity and functional activity are reciprocal phenomena and that the former cannot be maintained unless the organs are allowed to express themselves in work acceptable to them. We know definitely that overwork will have deleterious effects on the organs which are being overworked, if we bear in mind the overtrained athlete's impaired cardiac apparatus, the mechanic's thumb, the writer's cramped hand, the policeman's or the letter carrier's foot, the strained eyes of the seamstress, the boilermaker's impaired hearing as manifested in tone deafness. We could go on indefinitely showing impairment of organs which have been called on to bear undue stress. Here, then, we see in the general ensemble of the body that inhibition of function induces states of ill health. We all know that the teeth are a part of the human economy, a very important part indeed, and the same rules of conservative physiology which apply to the other organs of the body apply to them. If Nature points the way for us and, after millions of years of evolution, presents us with thirty-two distinct dental organs, each resting in its own individual socket, what arguments can we bring to bear which will justify us in violating this particular institution of the creative principle?

The things that I have told you are not new; they are not original; they are not destructive. They are as old as the world itself; they are constructive, if they are anything. If we were to take up any volume on physiology, on biophysics, on anatomy—any volume that is today accepted as a standard work, we would be forced, on reading any of these volumes, understandingly, to conclude that if we were to attempt to do any reparative work in the mouth, we would have to be guided in our work by the things that I have enumerated to you today. And if in the face of all this, we see a lot of reconstructive work which fails to adhere to even the remotest principle discussed today, we cannot but marvel at the perseverance with which habitual error seems to perpetuate itself in human thought and human effort.

In the issue of THE JOURNAL which recorded the proceedings of the Seventieth International Dental Congress, held in Philadelphia, there were addresses by a number of so-called leaders of the dental profession as chairmen of the various sections, and after reading these various addresses, coached in beautiful language, it appeared to me as if these spokesmen had attempted to beguile themselves with the concept that if they could but be permitted to indulge in a mass of beautiful, fine-sounding rhetoric, the errorful dental practice of today could be made to appear to the reader as the last word in correct dental practice. But I think time will prove that neither syntax nor rhetoric will take the place of persistent common-sense effort in removing or in segregating the chaff from the wheat.

Dr. Johnson, in an editorial, deplores the fact that so much chaos exists in prosthetic dental work and makes the statement that operative dentistry has at least been standardized sufficiently to enable the practitioner to do his operative work in a very definite way. This statement is not borne out by analysis and observation. We are constantly confronted with patients for whom operative dentistry has been done which needs to be redone. We are constantly confronted with patients who lose their fillings and their inlays and for whom operative restorations have been made without due

regard to consequences on the environmental tissues and consequently on the health of the entire oral mechanism. The opinions in regard to operative procedure differ as widely as, if not more than, the opinions and, therefore, the practice, in prosthetic procedure. How much accord is there in the profession today with regard to the treatment of so-called pyorrhea and gingivitis? How much accord is there today in the treatment of pulpless teeth? Indeed, how much accord is there today in the profession as a whole? What is the reason for all this discord but the inability to perceive the truth, and if there is any one sin that can be called the cardinal sin of the race, it is ignorance; because from that one void all other evils of the race arise or emanate. Dr. Johnson is quite correct in deploring the chaotic state of prosthesis. Look at the problem of occlusion and articulation in prosthetic dentistry and see the wierd variety of articulating machines that are being pressed on the practitioner. It is enough to bewilder the mind of a soothsayer, let alone the mind of the average professional man. But while all this chaos is bewildering and discouraging, to some extent it has in it an element of hopefulness which must ultimately result in clarifying the situation for a dental practitioner. There must come a time when all these things shall have been tried and, if found wanting, shall be dismissed, and out of these sporadic efforts of so-called inventors, there will come a clarified situation, with the rare facts gathered from experience illuminating the horizon of our daily practice and determining for us what we may safely use and what we must rigidly leave alone in the future.

Now, may I again be permitted to point out to this audience that I claim no originality of thought for things I have just told you. For the careful reading of any standard work on physiology, on biochemistry, on electrophysics, on mathematics, on philosophy, and the careful study of the contents of these books will force on us such conclusions as above expressed, and above all the careful observation of our clinical material in all its aspects of disease will impel the realization of the pitiful destruction initiated in the mouths of patients by our ignoring the basic principles of the law of motion and numbers.

There is nothing new, nothing speculative, nothing revolutionary, nothing destructive in our presentation. In fact, these principles are hoary with age, irrevocably established, entirely evolutionary and wholly constructive.

We can build our work in accordance with them and rear a structure upon a rock of ages. Training ourselves to acquire the manual dexterity to carry out our mental commands and persisting in our determination to enhance our skill in that direction will eliminate from our daily routine practice a thousand errors and a thousand hurts. Chaos and multiplicity of effort will give way to orderly procedure and simplicity of work and our striving in the art of replacement of missing teeth will become progressively more acceptable to our patients. The rich reward of their gratitude and appreciation will be added to the worthwhile consciousness that we have violated no biologic principle while filling a dental gap.

I have no quarrel with the men who deny the truth of what I have said except to point out to them that truth is eternal and triumphs over all in time.

It is an essential attribute of the minds of men to be skeptical of things not quite clear. Every votary of every doctrine has encountered it; all have met it.

In the days of old men were crucified for daring to stand apart—for daring to point the road to traveling homo. Moses never saw the promised land; Christ was crucified; Pythagoras was hounded out of home and country; Galileo was jailed; Copernicus was in disgrace; Harvey was ridiculed; and some great electrophysicists of today were thoroughly ridiculed ten or fifteen years ago.

It is fortunate for some of us that the methods of old in fighting innovations have changed and that we can keep on at our task with just incurring displeasure of our opposition, sometimes expressed in meaningless rhetorical exhortations to the profession to stand by the old order, and often in calumny and slander; but as I have said in the beginning, opposition is a spur to careful conscientious effort, and I am thankful for it.

I want you to know that if there is any credit due to any one for this labor, that credit belongs to you. Your need has been my inspiration, your woe my weal.

I bring you this message today in all modesty, in all gratitude, in all faithfulness. My reward comes with my service to you, if serve I may.

DENTAL GRADUATES CHOOSING LOCATIONS TO PRACTICE

By LOUIS OTTOFY, D.D.S., M.D., LL.D., F.A.C.D., Oakland, Calif.

IN a short time, more than 2,700 young men and women who are graduating from the forty-two dental schools of the United States will be seeking favorable "locations" to enter on the practice of their profession. To them the accompanying table will prove of interest.

NUMBER OF DENTISTS IN PROPORTION TO POPULATION

State	Population	Number of Dentists	Number of Persons to Each Dentist
California	4,556,000	4,679	974
Oregon	902,000	914	987
District of Columbia	552,000	539	1,025
Massachusetts	4,290,000	3,452	1,185
Washington	1,587,000	1,295	1,225
Wisconsin	2,953,000	2,355	1,254
Illinois	7,396,000	5,557	1,350
Minnesota	2,722,000	1,972	1,380
Nevada	77,407*	56	1,382
Nebraska	1,408,000	996	1,404
Iowa	2,428,000	1,717	1,414
Colorado	1,090,000	752	1,450
Missouri	3,523,000	2,419	1,456
Utah	531,000	339	1,566
New York	11,550,000	7,329	1,576
Indiana	3,176,000	1,992	1,594
Kansas	1,835,000	1,065	1,723
New Jersey	3,821,000	2,213	1,726
New Hampshire	456,000	262	1,740
Pennsylvania	9,854,000	5,644	1,748
Maine	795,000	450	1,767
Michigan	4,591,000	2,540	1,808
Rhode Island	716,000	393	1,822
Florida	1,411,000	740	1,917
Ohio	6,820,000	3,538	1,929
Idaho	546,000	282	1,936
Connecticut	1,667,000	848	1,966
Maryland	1,616,000	802	2,015
Wyoming	247,000	122	2,025
South Dakota	704,000	347	2,029
Vermont	352,428*	172	2,105

Jour. A. D. A., May, 1929

North Dakota...	641,192†	297	2,159
Montana	714,000‡	315	2,267
Louisiana	1,950,000	842	2,316
West Virginia...	1,724,000	687	2,509
Delaware	244,000	92	2,652
Tennessee	2,502,000	867	2,883
Oklahoma	2,426,000	812	2,986
Kentucky.....	2,553,000	816	3,130
Texas	5,487,000	1,694	3,239
Virginia	2,575,000	768	3,353
North Carolina..	2,938,000	864	3,400
Georgia	3,203,000	871	3,677
Arizona	474,000	127	3,732
New Mexico....	396,000	100	3,960
South Carolina..	1,864,000	455	4,097
Alabama	2,573,000	616	4,177
Arkansas	1,944,000	444	4,378
Mississippi	1,790,618*	333	5,377

* 1920.
† 1925.
‡ 1927.

The population given is the estimate of the United States Census Bureau as of July 1, 1928, except for Nevada, Vermont, Mississippi, North Dakota and Montana. For these, no estimates were made. The figures are for 1920. The population of North Dakota is based on a state census of 1925, and that of Montana on a similar census for 1927.

The number of dentists is as given in Polk's Dental Register, which was compiled last summer and fall. It contains the names of only a few of the 2,700 who graduated in 1928, the majority of whom at the time of the compilation had not established themselves or failed to report, or whose whereabouts after leaving college could not be ascertained. Hence, most of those 2,700 are distributed through the various states. The statistics relating to the number of dentists in each state is as nearly accurate as it is humanly possible for the publishers to make it. They spared no time or money to secure accurate data. I had personal experience in editing the last two editions of the Dental Register, and was afforded ample opportunity to learn something of the trials and tribulations attending an endeavor to secure accurate lists of dentists. In many of the states not even the board of dental examiners was able to furnish the information. Even during the time the Register went through the press, in so large a list containing the names of 67,000 dentists, many changes occurred owing to deaths, removals and other causes. Furthermore, such changes are taking place daily, and it is therefore impossible to make a list of dentists (or, for that matter, of any other professional or industrial group) which does not constantly change. However, for all practical purposes, the figures are sufficiently accurate.

At first glance, it would seem that California is the least, and Mississippi the most desirable state in which to locate. As far as California is concerned, this is undoubtedly true; but this does not hold good for the many states in which there is but one dentist to more than 2,000 of the population. In fact, there are many other considerations than the proportion of dentists to the population which are important governing factors in choosing a location. In California, which stands at the head of the list with one dentist to every 974 of its population, the situation is even more unfavorable than it appears. More than 200 dentists have established themselves in the state since last year. The foreign and alien population of the state should also be taken into consideration. Without disrespect to any race, it may be stated that Indians, Japanese, Chinese and Mexicans may not be estimated as an appreciable entity in the prospective clientele of the dentist. In a measure, this is also true of Europeans who become residents of this country, but who, by reason of their economic or educational status, do not constitute remunerative clients for the progressive ethical dentist. If these two elements

are subtracted from the total population, California has about 3,800,000 as a prospective dental clientele, many of whom are living on ranches distant from the centers of population. The number of dentists having increased by about 200, the total in the state becomes 4,879, and the proportion of the dentists to the desirable population becomes one to 779. There are two metropolitan districts in the state: Los Angeles and her environs, and San Francisco with the bay cities. In these, the combined population numbers 2,077,407, and the dentists 3,364, or one dentist to every 619 of the people, inclusive of Chinese, Japanese and Mexicans.

The overcrowded condition is painfully apparent. I am able to make these observations without bias, for although I am a resident of the state, I am not and shall never again be engaged in active dental practice.

On the other hand, Mississippi appears to be the state least crowded with dentists. But the state contains nearly 1,000,000 Negroes. In fact, the Negro population should be considered in relation to all the southern states beginning with Louisiana in the foregoing table. In addition, Texas, Arizona and New Mexico have a large number of Mexicans of the unskilled laboring class.

A study and analysis of the number of dentists in various cities, towns and villages of the country also shows remarkable discrepancies between population and number of dentists. For instance, there are cities with a population of 8,000 and only two dentists, and again towns with a population of 3,000 with as many as eight dentists. This state of affairs is no doubt governed by local conditions, such as proximity to other cities, the social condition of the people and their economic and educational status, and the like.

In justice to the approximately 2,700 dentists who have been graduated annually since 1925, it seems to me that there should be a survey of the actual conditions prevailing among dentists, covering the following points:

1. Has the campaign of dental education, which the dental profession fosters by means of the radio, the press and other agencies, increased the number of people who become substantial clients of the dentist?

2. Is the necessity for complicated, and therefore remunerative, dentistry diminished on account of the increasing dental care given to children of preschool and school age; and if so, to what extent?

3. Is less dental service required on the part of the people who have regularly patronized the dentist, on account of the present day average excellence of dental operations?

4. Does the increase in the use of artificial dentures (which last a long time, if well made and properly adjusted) decrease the number who continue to require the services of the dentist?

These observations are made because I note the constantly increasing attention given by dental societies to the economic problems of the dental practitioner; the frugal and businesslike conduct of the office; the exacting of adequate fees; the collection of outstanding accounts, and the method taught and recommended for increasing "business."

It may be worth while to consider whether a saturation point has been reached, and whether those entering the field at the present time are justified in looking forward to that adequate promise of economic success to which they are entitled by reason of the expense in time

and money involved and the importance and maintenance of the high standing of the profession to which it is entitled.

Finally, the only recommendation that can be made to those who are about to enter our ranks, is this: Choose a location where the people are intelligent, where the standard of education is high and where the economic conditions are sound and the people content, happy and prosperous.

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Editorials

THIS IS REFRESHING

After all the agitation over the status of the pulpless tooth, and the diverse opinions that have been expressed on the part of certain medical men and certain dentists, it is very refreshing to read in a leading medical periodical, *The Journal of the Indiana State Medical Association,* for March, an editorial entitled "The Inconsistent Craze for Removal of Teeth." This editorial written by a physician should tend to make some of the members of the medical profession pause to reconsider their attitude toward this subject. It would be well, if space permitted, to reproduce the entire editorial, but it must suffice to quote several statements. The editor refers to the "veritable slaughter of tonsils and teeth," and says:

> Insofar as tonsils are concerned, their removal, if done skillfully, almost invariably does no particular harm, even though the operation may not be indicated. In the case of teeth, the matter assumes an entirely different aspect. Perhaps it is true, as alleged by some dentists, that the medical profession has been over-exacting in the matter of removal of suspicious teeth, and many dentists have listened to specious but false advice on the part of some insistent physicians, and in consequence many teeth

removed which in the better judgment of the dentist could have been saved. At all events, this craze for teeth removal has gone too far, and both physicians and dentists now are coming in for justly deserved criticism for over-activity in that direction. It is no uncommon occurrence to have a young person, in fairly good health, present a mouth from which all teeth have been extracted and the patient compelled to wear plates both above and below. In some instances these patients have charged that the dentist rather objected to such wholesale slaughter but that the physician insisted upon it. Just why the physician should insist that his judgment should prevail as against the competent and trustworthy judgment of the dental surgeon is hard to answer. Certainly the physician would not countenance the dental surgeon's suggestions or advice in a case in which the teeth were not involved, so why should he tread on the domain of the dental surgeon? We might add that we do not think that the well-trained dental surgeon who has any independence of thought or action should be influenced by the opinion of any physician concerning what seems to be the proper course to pursue in a case in which dental pathology alone is to be considered.

It has been charged, and probably is true, that the merciless slaughter of teeth, so common nowadays, is due entirely to the insistence upon the more radical men in the medical profession that teeth suspicious to the medical man should be removed rather than treated. At all events, the blame perhaps should be shared equally, and both professions are coming into deserved disrepute for radicalism that is not only inconsistent but dangerous. This radicalism has gone so far to the extreme that a certain element in the medical profession, supported by another element in the dental profession, the latter probably incited by the former, is insisting upon the removal of dead or pulpless teeth, irrespective of whether a focus of infection exists or not. In other words, they seem to remove these teeth *on suspicion,* and in consequence many pulpless teeth that have been well and properly cared for by dentists years ago, and which continue to serve a useful purpose for the patient, are ruthlessly sacrificed in the effort to get rid of everything that seems to be suspicious. These same physicians, as well as dentists, who are sacrificing pulpless but uninfected teeth, may be overlooking a dozen far more dangerous foci, some of which may be obscure but nevertheless active, and all because the teeth in their exposed position offer a ready excuse for surgical interference. We have maintained, and we still maintain, that apical tooth abscesses are foci of infection that should be removed, and usually this requires the extraction of the tooth and subsequent treatment of the abscess cavity until it is clear of infection. However, the matter of losing teeth is of such moment, from a cosmetic as well as utilitarian aspect, that there should be good and sufficient reason for removal of any tooth, and to our notion the tooth that doesn't show evidence of infection either through inspection or x-ray examination, *should be left untouched.* This applies with equal force to the so-called dead or pulpless teeth that have been cared for properly by a dentist. We know of instances where dead or pulpless teeth have been carried from twenty-five to fifty years without producing the slightest discomfort or any evidences of infection of any kind whatsoever, and in our judgment to remove such teeth is a surgical crime whether it is recommended by a physician or a dentist. If the pulpless or dead tooth through inspection or x-ray examination *does* show evidence of

infection the story is quite different and we are willing to substantiate the opinion that removal may be necessary.

There is so much sanity in the foregoing editorial that it should appeal to every professional man who has anything to do with the teeth. As the editor intimates, no conscientious man would ever argue for the retention of pulpless teeth that cannot be made healthy by proper treatment, but that countless numbers of teeth have been sacrificed in recent years that might have been made safe and serviceable there is no question.

We are pleased to note that the editor refers in a complimentary way to an editorial on this subject in our esteemed contemporary the *Dental Cosmos,* for April, 1928. We would counsel those who have not read this editorial to do so, and this applies particularly to those who, as the medical editor has said, have gone too far in "this craze for tooth removal."

Let us have greater sanity and less sensationalism on this most important question.

PAINLESS PARKER OUSTED FROM COLORADO

March 4, 1929, the Supreme Court of Colorado rendered a decision of ouster on Painless Parker, and supported every claim made by the ethical dentists of the state. The court included dentistry with medicine and law as unlawful for a corporation to practice.

The thanks of the entire profession are due to the dentists of Colorado for conducting this case and bringing it to a successful issue. The case was long and bitterly fought, and it entailed a burden of worry and financial sacrifice on the part of the men of Colorado which would not have been endured by many members of the profession. This contest was fought not merely for the dentists and citizens of Colorado, but also for the profession of dentistry and the protection of the citizens of every state. There was a great principle involved, and if the ulterior forces had won, it would have started a demoralization in our professionl ranks the ill-effects of which cannot be estimated.

Manifestly, the case in all its ramifications is too long for detailed treatment in an editorial, but we trust that it may soon be prepared for the profession in such form that its significance can be realized by every member of the profession. We hope to have a statement of this kind in a future issue of THE JOURNAL.

Little by little, our profession is being established on a more stable basis, and this decision will go a long way to strengthen our position in the eyes of the public.

Congratulations to Colorado.

LIVE YOUR OWN LIFE

Why ape the thoughts or actions of every one you meet? Why not live your own life? If a good example is set you by others, there is no reason why you should not profit by it, but there is a very excellent reason why you should not invariably try to do the things you see others do, or do them in precisely the same way. If you have no initiative in life, you are a mere echo of some one else, and an echo never meant very much in the way of constructive achievement. Originality is needed in modern life: strike out and do something on your own account. The world has been advanced by the men who have pioneered in thought and who have scorned to do things just because others have done them.

Humanity would probably have been hanging in the limbs of trees, swinging from branch to branch and chattering in a jumble of sounds to this day, or at least they would have been living half nude in caves, if some one had not dared to do a little independent thinking and to defy precedent. What does precedent mean to men who have the courage to sail out on the sea of uncharted thought and to explore virgin territory? The unknown holds much of the promise of the future, and the man who lacks the vision to look ahead and see for himself must always trail behind in the procession of life.

The embargo placed on human thought by the superstition of the past has crushed out individuality and hampered progress.

Superstition has always put a lid on every worthy enterprise and made men afraid to think for themselves: it has always said that you must believe but you must not think. To think is dangerous—dangerous to the hosts of evil—and therefore to be discouraged by those of evil mind. There are many people who find it more convenient to believe as they are told than they do to go bravely out into new ventures of thought and action, and take a chance of being told they are radical.

The hue and cry against every independent thinker has ever been that he was too radical; often that he was unbalanced, and always that he was dangerous. The man who has had a comfortable time in life is the one who has gone with the crowd and never ventured an opinion of his own; but this kind of man has never added much to the sum total of the world's advancement.

If you wish to go through life as a nonentity, just follow the herd and never branch out into paths of your own. Never break a new trail and never step off the beaten road. The highways are filled with men who have never done anything distinctive, men who have never had an original thought or made an original move. There are so many of this type that the world is crowded with them.

The great thinkers are those who have looked beyond and ignored the rabble. They have not been content to accept an idea just because some one in authority has advanced it; they recognize no authority except the beacon light of truth; and they are determined to go where the truth leads regardless of whether or not they go alone. Most people like company when they go on any pilgrimage of life, but the really strong man of independent convictions will forego company if it is necessary to do so in order that he may think his own unbiased thought.

The world may spurn the independent thinker for a time, but eventually, if his ideas are original, virile and logical, they will finally fall at his feet; and frequently the man who has been the most reviled will end in being the most revered. The world is often fickle in its attitude toward men, and this should be a solace to those who today are being marked for the severest censure.

Tomorrow, the decision may be reversed and the outcast of thought may be acclaimed a benefactor to his race.

Public opinion, after all, amounts to little in the great scheme of life except as it affects those who are striving for the greatest good by diverting them from their main purpose. The man who means most to the world is the one who goes straight to his goal regardless of the clamor of the multitude, and who, when he finds a fact, sits serenely in the midst of the babble of tongues about him, thinks his own thoughts and lives his own life.

A BIOCHEMICAL VIEW OF ACID MOUTH

It truly may be said that advertising pages of scientific journals, if properly edited and censored, reflect the status of a science or profession. Nowhere is this more true than in the advertising pages of medical and dental journals. Yet if one reads carefully the advertising relating to dentifrices and mouth washes appearing in many of the dental journals, one is left in a quandary as to what sort of dentifrice it is best to use, if they can be used at all, to correct conditions in the oral cavity. Hence, the appearance of an article entitled "A Biochemical View of 'Acid Mouth'" appearing in a recent issue[1] of *The Journal of the American Medical Association* is timely and instructive.

Nowhere is scientific thought and even honesty more disregarded than in the pseudobiochemical propaganda inseparably connected with the exploitation of dentifrices and mouth washes. Consider, for example, what advertising writers are pleased to term "acid mouth." It is well known but not often admitted in the propaganda of certain dentifrice manufacturers that the p_H level of the saliva is maintained regardless of the material introduced into it. In 1920, Bloomfield and Huck gave human subjects as much as 20 gm. of sodium bicarbonate a day without effecting any change in the p_H value. Extending the range of experiments, Carlson and McKinstry of Oregon a few years later found among other results that acid or acid substances introduced into the mouth caused a marked increase in the p_H value, which lasted about ten minutes and then returned to the normal p_H value. Alkali or alkaline substances caused a marked diminution in p_H or increased alkalinity, which lasted for a few minutes and then returned to normal. From these and other results, Carlson and McKinstry rightfully concluded that mouth acidity or alkalinity cannot be

1. J. A. M. A., 92:899 (March 16) 1929.

controlled by any induced substances, regardless of its original strength or p_H value; i. e., the tendency is for the p_H value of saliva to return to the normal level of the individual. Other workers too have found similar relationships. Clark and Levine found that the chlorine content of resting saliva is not increased by ingestion of chlorides. Clark and Carter describe the tendency of the saliva to return to its normal state in the following words: "Accepting an average p_H of 6.6 [for normal saliva] it is evident that saliva is a well buffered mixture and would be able to neutralize large amounts of hydrogen or hydroxyl ions without showing appreciable change in the p_H value."

That the saliva is not a thing apart from other biologic phenomena is illustrated in other directions. Recently Chambers and his co-workers of Cornell University found in a series of micro-injection studies on lower forms of life that, as long as the injected cell remains alive, the p_H of any solution injected quickly changes to that of the protoplasm of any cell.

The main agreement between workers in what appears at first sight to be wholly unrelated systems is not without some significance for the claims made for the many dentifrices and mouth washes now on the market. Dentifrices of both acid or alkaline nature are sold with the claims that they will correct all sorts of supposed conditions in the mouth. Many of the alkaline dentifrices, presumably designed to correct mouth acidity (which in a sense is the normal condition), are especially blatant in their announcements. If an abnormal acid or alkaline condition is present in the mouth, there is probably an underlying constitutional cause which should have the expert attention of physician and dentist. Sooner or later, manufacturers of dentifrices will have to heed the results of scientific investigation. The chief purpose of a dentifrice is to clean the teeth or, more practically, to establish a healthy habit. The balance of evidence is against the view that dentifrices can be used for so-called mouth correction.

HERBERT LOCKE WHEELER

(1869-1929)

By W. B. DUNNING, D.D.S., New York City

Died of pneumonia, Saturday, March 23, 1929, in his sixtieth year, Herbert Locke Wheeler, D.D.S., Sc.D., F.A.C.D., F.A.A.D.S.

Dr. Wheeler was born in Corry, Pa., Jan. 23, 1869, and spent his early years and attended public schools at Hammonton, New Jersey. He graduated from the Philadelphia Dental College with the degree of D.D.S. in 1890. Dr. Wheeler began the practice of his profession in Warren, Mass., and in 1893 removed to Worchester, where he lived for eight years. In 1901, he moved to New York City and entered the office of the late J. Morgan Howe, with whom he was associated for a number of years. Since that time, he had continued in active practice in New York.

Early in his career, Dr. Wheeler became prominent in the work of dental organizations. As a member of the Institute of Stomatology, he took an active

interest in professional journalism. For several years, beginning in 1908, he was chairman of a committee which prepared the way for the establishment of THE JOURNAL OF THE NATIONAL (now THE AMERICAN) DENTAL ASSOCIATION. At about that period, he was active in the establishment of dental departments in H. Bartholomew's clinic and that of the children's aid society, of which, for a time, he took personal charge.

Dr. Wheeler was professor of prosthetic dentistry in the College of Dental and Oral Surgery, New York, for about ten years. He served for a time as member of the National Board of Dental Examiners and took an active interest in the affairs of the American Institute of Dental Teachers, the National Association of Dental Faculties and the Dental Educational Council of America. He served on the Council of the Dental Society of the State of New York, and the Legislative Committee of the American Dental Association. He was a fellow of the American College of Dentists and a member of the Sons of the Revolution and was active in various local clubs and societies.

During the late war, Dr. Wheeler was commissioned major in the Dental Reserve Corps, U. S. A. He headed a national committee for the establishment of an American hospital in Paris for wounds of the face and jaw, for which service the French government conferred on him the order of Chevalier of the Legion of Honor.

Dr. Wheeler's personality was aggressive and forceful, a rather downright but nevertheless attractive manner which secured to him many friends throughout the country. His interest in public affairs was broad, and his judgments were usually very definite.

Dr. Wheeler married Miss Gertrude Slater in 1891. Mrs. Wheeler and three children survive him—Clifford Slater Wheeler of Los Angeles, Arthur Chapin Wheeler of Noroton, Conn., and Mrs. G. F. Gardner of New York City. The funeral service, which was attended by members of his unit in the Army, was held at the Collegiate Church of St. Nicholas, New York. Interment was at Stamford, Conn.

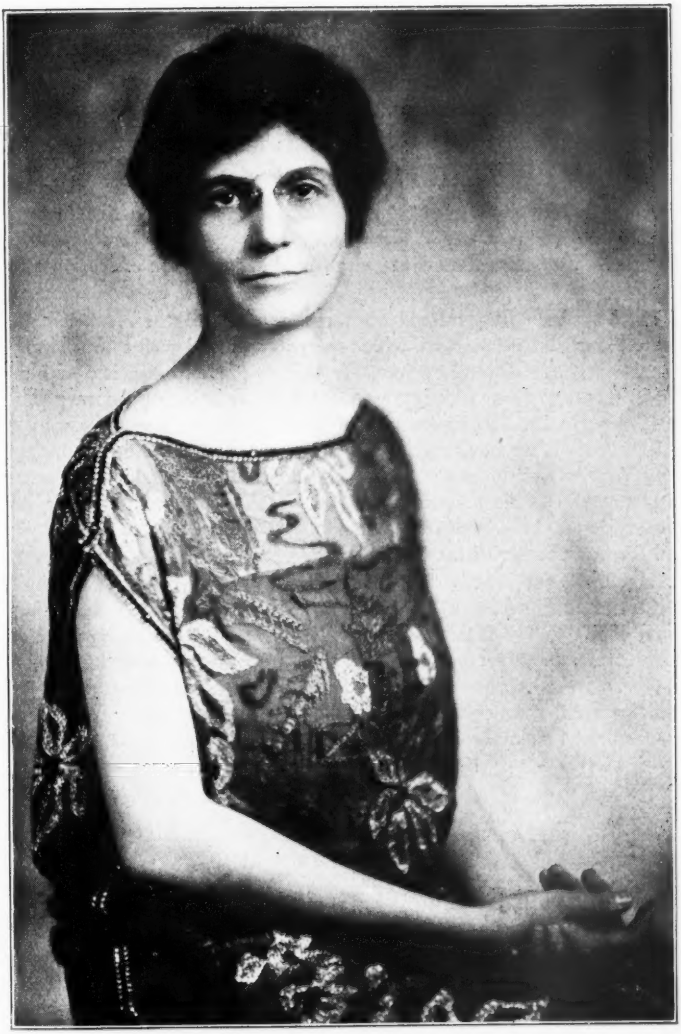
GILLETTE HAYDEN, D.D.S.

(1880-1929)

Gillette Hayden, past president of the American Academy of Periodontology and of the Federation of American Women Dentists and one of the foremost woman dentists in this country, died, March 27, at her home in Columbus, Ohio, one month after an abdominal operation.

Dr. Hayden was born on a plantation near Greenville, Fla., March 2, 1880. She was the eldest daughter of Horace William and Kate Bemis Hayden and a great granddaughter of Horace H. Hayden, pioneer dentist. She attended elementary school in Pasadena, St. Louis, New York City and Columbus.

In 1902, she was graduated from the Dental Department of the Ohio State University, being the third woman to graduate from that department. She spent the following year in postgraduate work at Northwestern University Dental School and entered practice, in 1903, in Columbus. In 1905, she became interested in the



GILLETTE HAYDEN, D.D.S.
(1880-1929)

prevention and treatment of periodontal disease, and that year she went to Dresden to further study and to practice this specialty. After three years abroad, she returned to Columbus, where she continued in the practice of her chosen specialty until the time of her last illness. Patients came to her from all parts of the world.

With Grace Rogers Spalding, Dr. Hayden took the first steps in calling together a group of dentists for the purpose of founding the American Academy of Periodontology, pioneer organization in periodontia. In 1926, she assisted in putting on a campaign for the establishment of free dental clinics in Columbus.

In July, 1927, Dr. Hayden presented her dental library to the dental department of Ohio University. She served as special lecturer to dental students at the university and was always interested in college affairs, being active in organizing the alumnae council and taking a special interest in co-ed welfare on the campus. She made protégées of several students who found acquiring an education a financial hardship.

Dr. Hayden was a frequent contributor to dental literature.

Among the organizations with which she was affiliated were: American Dental Association, Ohio State Dental Society, First District Dental Society of New York (associate member), Kentucky State Dental Association (honorary member), Northern Ohio Dental Association, Columbus Dental Society, American Association of University Women, Ohio State University Alumni Association, Ohio Historical and Archeological Society and Windsor (Conn.) Historical Society. She was also a member of the honor fraternity of Omicron Kappa Upsilon, president of the national Altrusa Club, chairman of the Ohio Branch of the National Woman's Party and former member of the executive board of the local Y. W. C. A.

Dr. Hayden is survived by her mother, with whom she lived, and a niece and nephew. Of her, a friend has said: "She was a skilful operator with the highest of professional ideals and a loyal friend to all her patients. Her unusual intellect innate refinement, modesty, culture, kindness and generosity endeared her to all who knew her. In short, there seemed to be no desirable trait of character or disposition which she did not possess. Always the first to praise and encourage and the last to condemn and then always with an understanding heart."

JAMES HARRISON PROTHERO

(1862-1929)

As we go to press, word is received of the sudden death of James H. Prothero, of Chicago, April 8, of pneumonia. Dr. Prothero was professor emeritus of prosthetic dentistry and lecturer on radiology at the Northwestern University School of Dentistry. A more extended notice will appear in the June issue.

BUREAU OF CHEMISTRY

THE AMERICAN DENTAL ASSOCIATION BUREAU OF CHEMISTRY AND THE PROFESSION

By SAMUEL M. GORDON, Ph.D.,* Chicago, Ill.

MANY requests for information concerning the work and aims of the A. D. A. Bureau of Chemistry have been received. In view of this fact, it has been deemed appropriate to outline the activities and objects of the Bureau and the services it offers to the profession at this stage of its development. Much is tentative and the years of experience to come will be invaluable in formulating a fixed policy.

DENTISTS AND DISHONEST PROPRIETARY EXPLOITERS

For a long time, the dental profession, as the medical profession before it, has been flooded with many essentially worthless proprietary remedies and remedies of limited value but exploited with gross exaggeration. These indeed might be properly included in the category of nostrums and quackery. In many cases, it has been difficult to differentiate between the so-called ethical proprietary and the "patent medicine" type because the profession was manipulated into the position of being the means of aiding in the promotion of many nostrums. The dentist has been in an even more disadvantageous position than has his medical confrère, since the physician who cared to avail himself of the services offered by organized medicine has, for more than twenty years, been protected from the importunings of quackery and dishonest proprietary manufacturers through the Council on Pharmacy and Chemistry and the American Medical Association Laboratory maintained in connection with it. The influence of this body on the development of therapeutics may be gaged from the fact that medical therapeutics has been raised by its efforts from crude empiricism to the status of a science. The realization of this state of affairs as contrasted with the present state of materia dentica, together with the fact that a relatively large number of quacks and dishonest proprietary exploiters are openly and brazenly operating among the dental profession, led many earnest dentists to pause and reflect. Indeed, a vast number of dental proprietaries are but the simplest of mixtures, or are well-known drugs put out under fanciful names, to no advantage whatever; or are absolute frauds and swindles. The experience of such a brief time as one year indicates that most of these remedies are exploited by men or "companies" who know little or nothing about dental medicine, pharmacy or chemistry, and who have gone into the business as they might have gone into any other get-rich-quick enterprise. A few—only a relatively few—products

*American Dental Association Chemist.

have been sold ethically and at the same time offered to the profession in a manner to inspire confidence.

Not only the character of the preparations but also the methods of exploitation are sad commentaries on, if not indeed a disgrace to, the profession which tolerates them. In brief, this business, the annual profits of which run into millions, has grown until the use of proprietary medicines by many dentists has almost displaced the use of the individual official drugs. It undoubtedly has checked advance in scientific methods of treatment, inhibited intelligent clinical observation and developed an optimism that is unwarranted by facts—an optimism that is more fatal than the most radical therapeutic nihilism. But, even worse, this commercialized materia dentica has blighted dental literature by debauching dental journals and even by tainting textbooks.

True, there have been spasmodic denunciations of this exploitation of the profession, but apparently organized dentistry was not yet awakened to the necessity for concerted action against these, the enemies of the dental profession. But no profession worthy of the name could forever remain heedless of such a state of affairs. Leaders of organized dentistry, recognizing the fact that the profession was being hurt, particularly by the none-too-scrupulous manufacturer, and by the lack of appreciation of this intrusion to the detriment of scientific dental medicine, began to take the necessary steps to correct this evil. Hence, it was not surprising that, at the 1927 Session of the American Dental Association, definite action for the establishment of a Bureau of Chemistry[1] to attack the proprietary evil was set afoot. The aid of the official organ of dentistry, THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION, was invoked in order to expose practices whereby dental offices throughout the country were being used as a dumping ground for preparations long ago exposed to organized medicine, but advertisements of which were received with open arms by the advertising departments of many dental journals and, sadder still, to be found in the armamentarium of either unthinking or uninformed dentists.

THE A. D. A. BUREAU OF CHEMISTRY

During the year following the 1927 meeting, the A. D. A. Bureau of Chemistry started functioning as an altruistic agency for the purpose of advising the profession and, equally important, acting for the benefit and protection of the public. The object of the Bureau is to protect the dental profession and the public against fraud, undesirable secrecy and objectionable advertising in connection with proprietary dental articles and quackery. Through a fortunate cooperative arrangement with the American Medical Association Chemical Laboratory, the excellent facilities and experience of this organization were placed at our disposal, for the prosecution of this work, solely under the auspices of organized dentistry. Thus, the Bureau started its work under favorable conditions.

The choice of articles for investigation was one of the first problems confronting the Bureau. Because there are so many preparations of unscientific character which are blatantly advertised to the pro-

1. The designation American Dental Association Bureau of Chemistry has been adopted tentatively for this activity. As the scope of the Bureau's work becomes enlarged, the name is likely to be changed. It is possible that the Bureau will find its purview extended to the examination of mechanical appliances, physical therapeutic apparatus and materials outside the range of dental medicaments.

fession and to the public, the difficulty lies not in an unfertile field for investigation, but rather in the choice of preparations on which the profession most desires unbiased information. Since the Bureau has been functioning, one report has appeared each month, commencing in the October issue of THE JOURNAL. Reports have already appeared on such products as Mu-Sol-Dent (The V. B. Corporation, Pittsburgh, Pa.); Tartaroff (The Tartaroff Company, Chicago); Semafor (The Indicator Laboratories, Chicago); Atomidine (Schieffelin and Company, New York); X-It (The X-It Laboratories, New York); and Ora-Noid (The Ora-Noid Company, Chicago). For a detailed description of the exposé of these products and their method of exploitation, the reader is referred to THE JOURNAL. Reprints of these articles are available to any one who sends in a stamped addressed envelop.

A review of these exposés will show that the Bureau has attempted to carry out the aforementioned objects fearlessly and consistently. The Bureau concerns itself not only with the chemical composition and pharmaceutic claims of the products, but with the advertising and therapeutic statements made in the exploitation of the product. The claims are compared with the results of the chemical examination and the present knowledge of pharmacology, biochemistry and therapeutics. The Bureau has been fortunate in having as collaborators men well versed in these fields. It is also worth recording that the intent of the Bureau is not to do an injustice to reputable manufacturers of proprietaries but to aid them to raise their standards to the materia dentica worthy of a profession which plays so important a part in the realm of public health and to help the profession rid itself of those who would exploit it merely for financial gain, and incidentally injure the health of the nation.

ENCOURAGING RESPONSE BY THE PROFESSION

The honest manufacturer will have nothing to fear from the activities of the Bureau. On the contrary, he, as well as the profession, will benefit by these investigations. Indeed, one object of the work is to encourage manufacturers who are willing to serve the best interests of the profession and to protect them against the almost predatory methods of dishonest exploitation.

That the publication of these reports has struck a responsive chord in the profession is evidenced by the large number of commendatory communications received since the publication of the first report. Many requests have been received for information on this or that product. As indicated previously, it is the policy of the Bureau to investigate those products for which the greatest number of inquiries are made. In view of the limited personnel of the Bureau, only those products which have a general rather than a purely local interest can be investigated. When the personnel and facilities of the Bureau are increased, as they must be to carry out the many demands made on it, attention will be paid to those products of somewhat lesser interest.

The appearance of these reports has already awakened an interest in the prescribing of drugs of proven value. Since the publication of the first report, inquiries concerning many products and preparations have been received from members of the profession. When the information is available, these communications are answered by direct correspondence. As the number of inquiries increases, the files under which these inquiries are indexed will become more

extensive and comprehensive, and should, indeed, prove to be a measure of the trend of dental therapeutics. It is, of course, understood that the contents of the advertising and scientific files are far from adequate, but the necessary beginning has been made. Additions are continually being made, and it is hoped that these records will be an increasing source of information to the profession and to the public.[2]

This service of the Bureau is available to all dentists. The Bureau aims to be to the dental profession what Dun and Bradstreet are to commerce, one difference being there is no cost to the individual dentist. In addition, the Bureau is indexing, as far as possible, biochemical literature of dental interest. This the Bureau feels is a necessary activity, in view of the many journals not readily accessible to the profession in which this literature is found, and to combat the quasiscientific claims being made in the newer forms of exploitation.

THE FUTURE

The dental profession, as all professions for the betterment of human welfare, must be ever mindful of the public. The public, in turn, has never, in the long run, failed that profession which, through a superior knowledge of its specialty, has shown altruistic interest in the health and happiness of the people of the nation. If for no other reason than the very fact that the dental profession is warning the public against the wiles of unscrupulous manufacturers and against the extravagant claims made for dentifrices, mouthwashes and the like, confidence in the profession is inspired so that an appreciation of this type of work will make itself felt both in a sympathetic attitude by the laity and in the halls of our legislative bodies.

Constructive criticism makes for progress. *The work of the Bureau is constructive in two directions:* constructive by destruction, using the word in its meaning of exposing that which is prevalent, but scientifically unsound; and constructive in the sense of aiding the profession to a materia dentica based on an increasing respect for scientific therapeutics by frankly commending preparations found to possess promise of therapeutic merit, which are honestly advertised.

Thus far, the Bureau's work has been of the critical exposé type rather than the purely constructive type. Circumstances surrounding the commercial domination of dental therapeutics and the impositions inflicted on the public as well have made it so. But, in the last analysis, the work of the Bureau is and will be constructive. In this critical phase of our work, we find an analogy in the proposed erection of a beautiful monument on a spot already occupied by an eyesore. It is hardly tautologic to state that, in such cases, careful destruction must precede construction. Carrying the analogy one step further: the prevalent use of essentially worthless proprietaries is the eyesore to be removed; the beautiful monument, a dental therapy based on the best available scientific knowledge.

It is encouraging to note that many dentists are awakening to the fact that they have been duped, and are eager to prescribe rationally on the basis of the individual patient, with drugs of proven worth. In general, drugs of proven worth do not come to the profession under the blatant verbiage of advertising writers in the employ of some exploiter. Those

2. It is worth noting that oftentimes the advertising matter and claims of many proprietary remedies assume a different complexion after an exposé.

that are found of permanent value are introduced to the profession only after they have been tested in the refining fires of laboratory and clinical experience.

Consider, for example, the so-called pyorrhea cures; and contrast the claims regarding them with actual circumstances. Some of the best brains are working on the problem of the prevention and cure of pyorrhea; so far, a satisfactory solution is not in sight. When it does come, it will come as a gift of dental science to humanity. It will not come in the form of a secret and mysterious combination controlled by a few individuals to be doled out to those who are able, or willing, to pay the toll demanded. It will be determined after a series of experiments carefully conducted under scientific control in various institutions and under the observation of disinterested scientific workers. Only under such conditions will it be possible to declare, with any degree of scientific accuracy, that a successful treatment has been established. Toward this goal, the Bureau wishes to encourage, as far as possible, all worthy endeavors.

Unfortunately, the individual practitioner has not had available on drugs of proven value the necessary unbiased information that would encourage scientific therapy. That the purely constructive side has *not* been neglected by those in charge of the work is shown by the initiation of plans for the formation of a body similar in purpose to the Council on Pharmacy and Chemistry of the American Medical Association. Scientists and dentists, each recognized in their respective spheres, are to be asked to serve on this body. Present plans call for a membership composed of one biochemist, one ceramic chemist, one bacteriologist, one physiologist, one pathologist and five dentists representing the various clinical phases of dentistry. In addition, it has been suggested to the Board of Trustees that the Editor of THE JOURNAL and the Secretary of the Association be appointed ex-officio members.

The work of this body will be to pass on the claims made for nonofficial (i. e., those not found in the Pharmacopeia or in the National Formulary) proprietaries submitted to it in the light of the available evidence, for acceptance or rejection, in accordance with certain fundamental principles for a list of accepted drugs, and to advise the dental profession on matters pertaining to chemistry, pharmacy and therapeutics. When called upon to treat a disease of the oral cavity, the intelligent dentist, like the intelligent physician, makes a diagnosis of the disease, learns its cause and removes it, if possible. On this principle, this body will attack its problems, and there will be many. It is quite likely that the Council will issue in book form its list of accepted drugs.

The Bureau will serve this body by carrying out whatever chemical investigations will be necessary in connection with the appraisal of articles submitted for consideration. Thus, the profession will have available the advice of some of the best minds in their fields for their guidance in daily practice. Indeed, expert and unbiased advice are found to be more and more necessary as the profession develops. It truly may be said that dentistry is in the midst of a slow but sure renaissance; for, whereas the emphasis previously has been placed on the reparative and mechanical aspects of the dental art, the emphasis is now being shifted to the preventive side of dentistry.

It is hardly necessary to state that an appreciation of the factors involved in this preventive aspect of dentistry will

necessitate an increased knowledge of the fundamental sciences such as biochemistry, including its nutritional aspects, bacteriology, physiology, endocrinology and the other basic sciences necessary in the endeavor to prevent disease. In this, the profession will have available the services of this Council. The membership of this body will be such that its decisions will be respected both in and outside the profession, and will, undoubtedly, be an honor and credit to the finer ideals of scientific dentistry.

As byproducts of the activities of the Council, we may look forward to improved facilities for instruction in materia dentica and pharmacology in dental schools; encouragement of *fundamental* research in dental therapeutics and a still higher standard in those drugs of established worth honestly sold to the profession. Jointly, the aim of the Bureau and the Council will be to so raise the standards of dental therapeutics that the label "Accepted by the American Dental Association" will be a goal for the manufacturers of medicaments to strive for, and for the profession to follow. To this end, the support of every member of the profession is needed.

WHAT ARE YOU GOING TO DO ABOUT IT?

There have, no doubt, been some changes for the better since the Bureau started its work. As an example, a few weeks ago the Bureau received a communication, in reply to an inquiry sent to a manufacturer, that the term "pyorrhea" on new containers will be discontinued in the future. This is indeed significant in illustrating that proprietary manufacturers are alive to the awakened interest on the part of the profession to protect itself and the public, through this activity. But the A. D. A. Bureau of Chemistry and the proposed Council are and will be purely advisory bodies: there is no law that will compel the manufacturers to recognize it or to comply with its findings. Hence, without the support of the profession, its work will be of no permanent value. The support must be more than passive. Simply endorsing the work by words or praise or by that indefinable something called moral support is well enough as far as it goes. But if definite, permanent, tangible results are to follow, the profession must act. If it does not act, and does not back up this work, we shall not get away from the conditions that we are trying to escape: we shall even drop back more.

HOW THE DENTIST CAN HELP

This movement was inaugurated directly for the benefit of the dental profession and indirectly for the benefit of the public. There is no question as to the final success of this movement for reform, but the work will be greatly facilitated if you who are interested will:

1. Use those drugs or mixtures that are official in the United States Pharmacopeia and National Formulary, and prescribe not by fixed rule of thumb, but according to the individual patient.
2. If you use proprietaries,[3] ask the

3. It is not our intention to group all proprietaries under one heading. It must not be overlooked that there are many proprietaries which represent some advance over official drugs. These should not be confused with the large number of products sold under some coined and uninforming name, which, in general, are well known drugs, mixtures thereof or unessential modifications. Examples of worthy proprietaries that show promise of therapeutic value in medicine, for example, and are *honestly* advertised may be found described in the book "New and Nonofficial Remedies," published by the American Medical Association. This book helps the physician to make a discriminate selection of new proprietary remedies. It may be stated that if a proprietary advertised to physicians is not listed in "New and Nonofficial Remedies."

manufacturer or your dental supply house for the qualitative and quantitative composition of each proprietary. Then convince yourself that the proprietary is better than the product official in the Pharmacopeia. If you cannot get the information, write to the Bureau, and it will advise you according to available evidence.

3. Look over the advertising pages of the dental journals that you are receiving, either by subscription or gratis, and since editors and publishers have great respect for the opinion of their subscribers, write asking for a square deal in the advertising as well as in the reading pages.

The Bureau is sure that every earnest dentist, unless he has some interests on the other side, believes that the movement is a good one, deserving of all the support that the profession can give it.

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it has been found wanting; or is not deserving of consideration by the intelligent physician. It is hoped that a book of similar nature, adapted to the needs of dentists, will be offered to the profession by the "Council" of the American Dental Association.

BUREAU OF DENTAL HEALTH EDUCATION

TREATMENT OF POOR APPETITE DURING DENTITION PERIOD*

By C. A. ALDRICH, M.D., Winnetka, Ill.

WHILE the material presented in this paper does not bring to the dental profession a therapeutic measure for their own use since its members are seldom called on to treat poor appetites, it may be interesting because it concerns a subject of primary importance to oral hygiene, the influence of diet on the formation of teeth. Within the past twenty years, we have seen the mortality rate among infants in our better communities reduced to an almost negligible percentage. We have seen the ravages of many of the more serious diseases vanish into the dim past. We have learned a great deal about the proper food to present to children, and have at our disposal the means to make practically every baby who is not congenitally diseased or deformed a healthy specimen. Flushed with enthusiasm, we suddenly find this utopian goal blocked by an entirely new and unexpected factor, widespread refusal of children to accept the prescribed diets. Since this influences the food taken, it affects the quality of the teeth. Therefore, we will be concerned in this discussion with the problem of how, not what, to feed children. Those of you who are parents of young children may get some practical points for home consumption.

This subject sounds innocent only to those who have not experienced the difficulties and woes directly attendant on it. Those who have struggled through weeks, months and years with the appetite problem will grant that unhappiness and strife are constant attendants on the children involved, which is an aspect of the situation which is of major importance.

Ralph Hamill, in a recent discussion, brought out the fact that, according to the behaviorists, all of our reactions to stimuli are dependent on early conditioning which is based upon primal sensations such as fears and pleasures apparently inborn. It would seem logical to suppose that the individual who has been predominantly conditioned on the basis of fear or unpleasant sensations would tend to be unhappy; whereas, the one predominantly conditioned on the basis of comfortable or pleasant sensations would tend to be happier. In other words, the usual type of reaction of an individual might depend largely on the type of his early conditioning, pleasant or unpleasant. It would seem probable, therefore, that the more pleasant sources provided the individual, the happier he might turn out to be. Does it not seem

*Read before the Section on Mouth Hygiene at the Midwinter Clinic of the Chicago Dental Society, Jan. 15, 1929.

probable that this enjoyable reaction to food which the normal new-born feels is a primal pleasure along with such a sensation as warmth? If this is true, the maintenance of good appetite takes on an additional importance; for thus we not only assist in maintaining good nutrition and in avoiding a source of strife in the family, but we also furnish a source of happiness to the child. Where good appetite prevails, all of the concepts associated with meals will probably be colored pink; where meals are looked on as a chore or with actual distaste, they will be tinged with gloom.

I mention this to emphasize further that, in discussing this topic, we are not merely chatting about children's troubles, but also are dealing with a most important subject, concerned with the physical well-being and the mental health of children.

By way of orientation, it may be well to say a few words so that we do not misunderstand each other. This is not a talk on malnutrition, but a discussion of children's appetites. In attempting to cure malnutrition, one may actually interfere with the development of appetite; whereas, by improving appetite, it is easier to secure good nutrition. It is as though an army were attacking a foreign capital before which lay a railroad junction insignificant as to size but all important strategically. To aim an offensive directly at the capital might be folly until the junction had been controlled. Thus, it may be foolish to center our efforts on the cure of malnutrition until we have first invested the "key to the calories," good appetite.

It may be well to remember that the science of modern pediatrics is in its infancy, and that the appetite problem also is only a few years old. The fact that widespread refusal to eat on the part of children has appeared at the same time in which we have become keenly interested in the nutrition of children is probably of more than passing significance. Perhaps in our first enthusiastic application of newer knowledge, some lack of consideration of the child's normal inclinations has produced this abnormal reaction of his. Let us take stock and consider the child's appetite from a physiologic point of view. Perhaps, we may thus be able to understand this baffling situation, his refusal to eat willingly.

There are two physiologic factors controlling eating, hunger and appetite. Hunger is an uncomfortable sensation due to lack of food. Appetite is a desire for gratification. In the normal human being, the mechanism by which these two factors compel adequate consumption of food is probably as follows: Hunger contractions occur when the stomach is empty, causing uncomfortable abdominal sensations. Since these have always been relieved by food, its memories, and those of the associated tastes and odors, become pleasant, and appetite develops on this basis. In the meal which follows, appetite stimulates us to eat our fill long after hunger contractions have ceased, and the stimulating effect of appetite on gastric secretions helps us to digest our food. Satiety, by some unknown mechanism, puts a stop to our eating.

The causes of poor appetite, then, will have to include all the factors which tend to reduce or interfere with the harmonious interplay of these two stimuli. The more one studies the ways of nature in physiology, the more one is inclined to respect them. The more one considers the delicately ordered mechanism of hunger, appetite, satiety and good digestion with which we are normally endowed, the less likely one will be to tamper with it. One would not try to

regulate the number of cubic centimeters of air a child should breath. Why should we try to prescribe the number of calories he should eat? The respiratory rate, you say, is regulated by an extremely sensitive chemical and nervous reflex which is automatic. Has Nature, then, in the matter of eating, been less careful to provide an adequate mechanism? Obviously, in that event, you and I would not be here today. Nature is not at fault. She has provided adequately. In the past, her provisions have worked successfully, but now, in one class of children, they seem to fail. It behooves us to eradicate the specific cause of failure rather than to overthrow the natural law and try to assume to ourselves the power to regulate the function of eating.

Of course what has just been said applies only to the amount of food. It cannot, in this day of artificial catering, apply to the kinds of food offered. Nor does it apply to sick or abnormal children.

At the present time, scientific research is testing the adequacy of these normal stimuli to eating. Clara M. Davis[1] began about three years ago to feed young infants a self-selected diet. She began her work in an attempt to find out what the wild human being would eat if left to his own devices. Exclusively breast-fed babies were suddenly weaned and offered trays of food giving them a wide selection from which to choose. They were allowed absolute freedom to pick and choose what they could get from the tray, and the nurse in attendance was instructed to assist them impartially in their desires. These children were never allowed to see others eat and were not even told the names of the different foods. Only such foods as are found in nature were offered and no seasoning was added. About twelve different foods were placed upon each tray, the relative positions of the different varieties being constantly changed. The following is a fairly comprehensive list of the foods given: water, sweet and sour milk, sea salt, raw and cooked apples, bananas, pineapples and peaches; orange juice, raw and cooked vegetables, raw and cooked cereals, raw and cooked meats, bone marrow, fish and eggs. Cod liver oil was offered and accepted by one infant who had rickets.

Thus far, about ten infants have been so fed, but of these only three have been followed long enough to furnish data of value in this connection. The results have been astonishing in many ways. The children are all above average weight for age and height, and are all good eaters. None of them has ever had an intestinal upset except during acute infectious diseases, which have occasionally complicated the experiment. No child has ever been given a cathartic. Although each child has had sprees of eating large amounts of one food over a period of a few days (one child ate seven eggs at one sitting), taken over monthly periods the ratio of the various food elements consumed does not vary by 1 per cent. Each child seems to choose his own ratio to which he clings. They eat little besides fruit and milk for breakfast. They eat sparingly of vegetables. Some of them prefer sour to sweet milk. They eat more protein foods than we have thought advisable. If time permitted, I could say more of this remarkable work and its application to this theme, but I simply mention it as proof that, even today, appetite, if left alone, still functions.

1. Davis, Clara M.: Self Selected Diet of a Newly Weaned Infant, J. A. D. A., 14:1119 (June) 1927; Self Selection of Diet by Newly Weaned Infants, Am. J. Dis. Child., 36:651 (Oct.) 1928.

But returning to the causes of poor appetite, the following outline will give some idea of the field to be covered. While I can do no more than read it here, I want to emphasize that in the individual case all of these causes must be considered.

OUTLINE

The causes of poor appetite are as follows:

I. Psychologic causes:
- A. In the child
  - (a) Negativism
  - (b) Desire for attention
  - (c) Attempt to obtain desires
  - (d) Interest in other things
  - (e) Desire to go out and play
  - (f) Imitative nature.
- B. In attendants
  - (a) Multiplicity of methods used.
  - (b) Too many attendants, each with a different method
  - (c) Wrong methods in general psychologic handling
  - (d) Lack of education or purpose—haphazard methods.
- C. In the technic of the meal
  - (a) Forced feeding
  - (b) Oversolicitous, hovering attitude
  - (c) Too much talk about eating habits
  - (d) Too much discipline, especially stressing of manners
  - (e) Emotional strain at the table or before eating
  - (f) Story telling or other stunts as a reward for eating
  - (g) Unpleasant surroundings at meals
  - (h) Too much time allowed at meals

II. Physical causes:
- A. Disease processes
  - (a) Infections, practically all acute and chronic types
  - (b) Organic disease, especially of heart, lungs and kidneys
  - (c) Teething
  - (d) Anemia
  - (e) Disturbances of function: endocrine glands, celiac disease, secretory and motor abnormalities of the stomach
  - (f) Mental disease
  - (g) Malignant tumors.
- B. Hygienic causes
  - (a) Lack of fresh air
  - (b) Lack of exercise
  - (c) Lack of sunlight
  - (d) Lack of sleep
- C. Dietary causes
  - (a) Overfeeding, general or with any one food, such as milk
  - (b) Too short intervals between meals (eating between meals)
  - (c) Too much of foods rich in fats
  - (d) Lack of vitamins
  - (e) Food idiosyncrasy
  - (f) Constipating diet
  - (g) Too much sweet or starchy food.

Our problem is to prevent these influences from destroying the appetites of children, and, to that end, the following preventive technic is suggested.

Propaganda.—As the first and most important means of prevention, education is proposed. To be of real value, information on this subject should reach nurses, doctors, welfare workers, prospective parents and, I think very properly, dentists. It will be less valuable if it reaches a mother after the habit of refusing food is established in her child. It should be taught that poor appetite should be reported to the physician as soon as would fever, vomiting, etc.

Avoidance of Forced Feedings.—In the propaganda just mentioned, it would be emphasized that no child should be forced to eat without careful consideration of the possible consequences. The case against forced feedings rests on the fact that it has been tried and found futile as a means of insuring adequate food intake, and is harmful to the peace of mind of the household.

Prevention in the First Days of Life.—During the baby's first few days, Nature has provided no food for him although he seems hungry. During this time, some seem definitely in need of water, so this is routinely provided. It has recently

been maintained that they also need food, and under the stimulus of that idea, it has become common in many hospitals to provide supplemental food for newborn infants before the establishment of the breast-milk supply. It seems to me that this is undesirable because it interferes with the development of hunger by keeping the stomach partly full of food. The baby who has this first hunger appeased by any sort of bottle food will be less eager for the breast and will nurse less vigorously. He may even prefer the bottle to the less easily managed nipple of his mother and thus present an appetite problem from birth. As a rule, nothing but water should be given the baby until the flow of breast milk is established. Premature, congenitally weak, or diseased infants are obvious exceptions to this rule.

Bottle and Spoon Education.—As a second step, we take an apparent about-face. Just as withholding the bottle in the first few days is important, so the presentation of this same bottle is necessary during the first month. This is because it is desirable that the baby accustom himself to the feel of the rubber nipple and to the taste of artificial food before his appetite is formed for breast milk exclusively. Since appetite is a memory complex, we would expect no child to have an appetite for the bottle who had never tasted it. We therefore should give it occasionally while hunger is the main stimulus for eating, so that the baby will naturally develop a pleasant memory of artificial food.

Likewise, it is advisable to begin feeding cod-liver oil in the spoon at this time, so that we can develop the baby's taste for this food before he becomes too discriminating.

Cereal should be fed in a spoon at about the fourth month. It should be flavored with the familiar bottle food, and plenty of time should be given for the child to accustom himself to the new method before any large amount is tried.

Prevention of Weaning Difficulties.—As many cases of disturbance of appetite have their onset at the weaning period, it is important to watch it closely. From the standpoint of appetite, we prefer it to be a gradual process and should plan the feeding campaign to that end, so that there will be few sudden changes.

If a baby approaching the weaning period has been educated to take the bottle and spoon, no great difficulty should be experienced. Otherwise, he may refuse artificial food, and a serious situation arise from the standpoint of his immediate nutrition as well as from that of his future appetite. When faced with the problem of refusal to take artificial food at this time, I have found it more satisfactory to take rather drastic steps and to allow the baby to become acutely hungry before offering him anything than to try gradual reduction of the food. After a preliminary starvation of from eight to twelve hours, it is well to offer him 2 ounces of skimmed milk only. If, as is usually the case, he takes this well, 3 ounces may be given at the next feeding and the amount increased gradually, care being taken that it does not increase as fast as his appetite diminishes. In this way, our conscientious objector emerges a wiser though hungry child with a good appetite; whereas, if the full bottle is continually pushed, squeezed and squirted at him, he emerges with no appetite at all and often hungry notwithstanding our efforts to feed him.

Prevention of Objection to Later Changes in Food.—If we are trying to develop in the baby a pleasant concept of food, it is important that changes in the character of his food do not give rise to

unpleasant struggles. This has already been attended to in the first few months; but soups, vegetables and numerous other adult types of foods will later have to be given. These should be added as early in life as possible, and great care should be exercised that, at no time, he be urged unduly as to amounts of these new foods. Each new food should be given over a long enough period to accustom the baby to its taste before a new one is started. It may be necessary at first to camouflage vegetables in cereal, gradually increasing the amount of the vegetable and decreasing that of the cereal.

It is best, at this early period, to pay attention to the apparent whims of his appetite and give most often the kind of vegetable or cereal he likes best. This will increase his enjoyment of the meal.

Prevention of Overfeeding.—If we are to develop good appetites, we must be careful not to overfeed the nursling. Appetite, like any other faculty, will be made more keen by its exercise. Except in extreme cases, no increase in formula should be made unless each bottle is drained. Failure to gain weight satisfactorily when combined with poor appetite in a very young infant means that there is something wrong with the formula or with the baby. It should call for increase in the food intake only after careful consideration of these possibilities.

The baby who is making an average increase in weight should not have an increase in food unless he is ravenously hungry. Then an attempt should be made merely to take the edge off his appetite.

It must be emphasized that mere size in a baby is a minor consideration. Mothers must understand that steady gain in weight is more to be desired than rapid gain, and that a small baby may be physically superior to his fat neighbor.

Treatment of the First Attack of Anorexia.—This is an important part in the prevention of habitual poor appetite and is almost always necessary during the first year. When a previously hungry baby first refuses food, our response should always be a reduction in the amount offered him. On no account should he be urged to eat at this time. A minor illness usually follows this symptom.

If this rule is followed, there will be no children who have poor appetites because we have forced food upon them at a time when they were physically unfit to assimilate it.

Value of Study of Psychology to Parents.—During the first year, all parents should study the subject of child psychology. This reading is a real preventive step because, thereby, an insight is gained into the child's attitude of mind, which makes the development of anorexia less likely.

Prescribing of No Caloric Diets.—It is considered inadvisable to prescribe definite amounts of food to the normal child over 1 year of age. If the previously outlined technic has been followed, we may confidently expect appetite to guide the child in the amount he eats.

In the management of the child who sits at the table, it is important that we consider the technic of his meal, and the following outline is given with the realization that it is only a beginning and may be changed as new ideas are forthcoming.

TECHNIC OF THE MEAL

Pleasant Surroundings.—The entire process of eating should be decked with pleasant sights, words and sensations, so that the child's thoughts will also be pleasant. The process of eating should never be put in the same category as

brushing the teeth, bathing and going to bed. Try to develop the "Hurrah! Let's eat" attitude. Visit a large children's institution, such as an orphanage, to get the spirit. Meals are the big times of the day in such places; which is as it should be.

Detached Attitude of Attendants.—The attitude of those who supervise children's meals should be detached and carefree, not hovering and solicitous. It is evident that by following this method, we avoid the danger of allowing the child to use refusal to eat as a means of obtaining special favors and attentions.

Story Telling.—It is best not to tell stories at meal times. Stories may be permissible as a means of creating a pleasant atmosphere, but they never should be a reward for eating and must not deal with that subject. Here, the difference between good and bad technic is a mere shade, but all important.

Avoidance of Strong Emotions.—Strong emotions should never be evoked at meal times. In this, we must be ever watchful. If a boy is likely to have a tantrum if he is asked to wash his hands before dinner, in the interest of appetite we should not ask him to do so. This advice is open to criticism, I know, but it must be insisted that appetite and hunger both disappear with the advent of an emotional scene. I would rather have my child eat with unwashed hands than have him refuse entirely or be forced to eat. The cause of tantrums should be treated, of course, but not at meals.

Moderate Helpings of Food Advisable.—Plates should not be piled high with food. It is advisable to put so little on a dish that a second helping will be welcomed. The sight of too much food decreases appetite, the sight of a little stimulates it. The second helping should be given reluctantly.

Avoidance of Too Many Services.—It is often a good plan to serve a plate lunch. Many times, a child with negativisms will refuse to take helpings from the attendant. If he is served all the different foods on one plate, he has but one opportunity to refuse in place of many.

Refusal of Food.—If a dish is refused, it is often best to terminate the meal without comment. This should not be enforced when it is known that the child has a real aversion for the refused dish. Do not offer such foods. They tend to spoil his attitude toward meals. In my experience, to make a child "eat everything, so that he will like everything when he grows up," usually means that very soon, he likes nothing.

Avoidance of Argument.—The child often refuses food in order to be important; therefore, argument on the subject satisfies this desire. Silence removes the zest in his not eating.

A Reasonable Time for Meals.—If an occasional meal is cut short because of dawdling over food, this is not likely to recur. The meal should not be hurried, but about one half an hour should be long enough.

Setting the Child a Good Example.—It may be necessary for both parents to eat carrots and spinach.

Avoidance of Disciplinary Measures at Meals.—Do not haggle about manners. These can easily be taught later on. Early childhood is a time in which to develop good appetite and in which to reap the benefits which follow it. It is not the time to spoil the attitude toward food by censorious talk. Termination of the meal is the best disciplinary measure applicable to meal-time misdemeanors. I long for the good old times when a child was sent to bed without supper as a punishment. At least, such a one would

not hold the "big stick" of refusal to eat over the heads of his parents.

This completes a brief outline of some of the measures which may be used to protect children's appetites. But a discussion of this sort will not be complete without a statement as to what should be done about the unfortunate who has lost his desire to eat. This subject can best be divided into two parts, the treatment of those not long afflicted and that of those who are chronic sufferers, so to speak.

Treatment of Cases of Short Duration.—This subject has already been touched on in the previous pages and little more need be said. Here, the keynote of therapy is reduction in the amount of food offered the infant who does not drain the bottle, the child who doesn't clean his plate, or the one who vomits if fed after he indicates that he has finished. The degree of food reduction will vary with the case, from temporary starvation to so slight a change as skimming the milk, which is often sufficient. As soon as signs of returning appetite appear, the diet is slowly increased. If this method is accompanied by the proper attitude of the attendant, absolute indifference, difficulty in accomplishing the cure will seldom occur. If the young child who has recently begun to refuse does not respond within a few days to such a régime, thorough search for a physical cause for the trouble should be made.

Treatment of Cases of Long Duration.—Here, we come on the most difficult and perplexing phase of the subject, one of the most perplexing problems meeting us today. How can we develop appetites in children who have had appetite educated out of them? An accurate diagnosis as to the cause is essential in the treatment of these children. This takes time, patience and experience. All of the predisposing causes should be considered in turn, for here the omission of a single detail may spell failure.

Thorough search for physical causes must be made, and defects, if found, remedied. If, in the following discussion, I omit further reference to this topic, it is not because I do not grant physical defects to be causes of anorexia, but because their treatment is a matter solely of pediatric responsibility, and it is easy as compared with the handling of the psychologic factors.

Sometimes, the child's history will bring us abruptly to a correct diagnosis. Painstaking note of the answer to this question, "What happened when we first noticed the lack of appetite?" may lead the way to cure. It is easy to find the cause in the infant who has just begun to refuse, but it will not be so easy to recognize a simple weaning difficulty as the main factor in the poor appetite of a child when seen at 4 years of age. Yet such is often the case. If the difficulty dates back several months and there is no adequate physical cause discernible, a diagnosis of psychologic aversion for food may be made. But here our diagnosis is still incomplete. What are the psychologic factors at play? Is this child a victim of negativism? Is he using refusal to eat as a method of obtaining attention? Is he using it as a "big stick" in order to obtain favors? Does he get enough of the proper kind of attention? Is he nagged? Is he undisciplined or overdisciplined? Is he happy? How do his brothers and sisters—yes, and his parents—eat? How many people supervise his activities and how intelligently are they doing this? And so on. I could enumerate dozens more questions that should be answered before we can come to a sympathetic understanding of the problem which any one of these children

may present. It is our duty to ferret out as far as is possible the factors at fault.

Having arrived at a diagnosis of psychologic aversion, one must be sure that all attendants understand the problem. All must at once realize that nothing can be done unless they temporarily forget about the subjects of food intake and gain in weight. They must see that, to attain good nutrition, they must first develop a good appetite in the child and that this first objective has nothing to do with the amount of food eaten but has everything to do with how the child anticipates his meals. They must think only in terms of appetite. Just as in adult life we give up pleasures of the present in order to secure greater ones later on, so here we have to forget the food intake of today in order to make sure of that of the future.

Secondly, they must realize that psychologic cure is impossible in a short space of time. They may be fortunate if good appetite is restored in a year or more. Neglect of these considerations may result in complete failure before the cure is fairly started. (Often mothers have reported failure to me after two or three days trial, when I had told them that weeks of effort might have to be expended before seeing results.) Often, other uninstructed members of the household may, in a word or two, spoil all the good that physician, mother and nurse have done in weeks of patient effort. A family party in which the physician can cooperate should be a preliminary measure. In this regard, the psychiatrist has been far ahead of the physician.

After an explanation of the nature of the ailment, those who will come into intimate contact with the child should be instructed as to the proper management of the meal. As I have previously outlined, this will tend to prevent increase in the difficulty, but often will not cure the child.

This brings up a point which I am particularly desirous of emphasizing. Having told the attendants of a child with chronic poor appetite all about the proper technic of the meals, and having explained to them the reasons for the difficulty, the method of cure is still not established. In other words, many children who have long been deprived of good appetites will not respond to treatment which merely rectifies the faults that have produced the trouble. The burned leg does not heal because the fire is removed; in fact, it may never heal unless we apply with all the skill at our command those measures which seem best adapted to the case, and even then scars are likely to remain. Just so, these appetites have been burnt, some of them to a crisp. We not only have to remove the fire of forced feeding and to apply the soothing unguent of proper meal time technic, but we may also have to resort to grafting operations because of scars and failure to heal. We have before us here the problem of reeducating into these children new appetites.

What measures can we recommend which will tend to reeducate appetites into children? The possible methods are limited only by the ingenuity of the physician and the parent. It remains for me to enumerate some of those which I have found most useful in my own experience. It will be noted that the general principle involved is to apply some measure which will make food seem more desirable to the child. The method of choice in each individual case, of course, will vary with the psychologic factors to be faced. If we are successful in making the child want food, we can say that we have begun to educate his appetite, that the graft is taking. With continued care, we may

expect it to grow into a healthy and serviceable member of the body.

Treatment of Negativism.—Negativism is a frequent cause of poor eating habits. The child's first reaction to a command or a request is an act in the opposite direction from that desired. Obviously, one cannot hope to educate such a child into the desirability of food by telling him to eat it. Quite the reverse. He will want to eat more if food is withheld, if he is continually told that he cannot or should not have so much of this, that or the other thing. We should always be sure to indicate that the things he should not have much of are those which we most want him to eat. Ask any one to name a list of the things her negativistic child does not like. It will coincide startlingly with the things she thinks are most necessary for the child's best nutrition.

In advocating such a method, I realize acutely that I am laying myself open to the charge of being dishonest with the child. This is true in a small way, but in a larger way it is not so. By such a method, dishonest and sharp though it may be, we are striving to teach the child a great truth, the joy of a good appetite. Probably this has been destroyed by an honest but "dumb" technic of feeding. I can only advise you to "let your conscience be your guide." Of course, this should be a temporary expedient only.

As to the efficacy of such methods properly carried through there can be no doubt. I have seen cures produced in this way with unbelievable and almost ridiculous rapidity.

The exact method of telling a child such an "untruth" may vary. One may simply give the child an extremely small helping and refuse the second, or give it finally with a remark that the doctor will not like it. In another case, the physician may emphatically tell the child that he cannot have so much of various foods, and tell the mother, in the child's presence, to see to it that his orders are carried out. One such child went out of my office saying "Do we all have to do what Dr. Aldrich says?" He immediately began to think pleasantly of food.

It may be worth while in such a case to have someone in authority in the family repeatedly appear at the child's meals and take away his food, saying that he will overeat, and berating the nurse or cook for offering him so much food. This maneuver is usually met by a wail from the child to have his food returned. The greater the scene produced in this method, the more the child is impressed with the inaccessibility of food, and therefore with its desirability.

It may be worth while to tell the child that you are putting him on a diet. (It is surprising how many of them know what that means. They have learned to associate diet with reduction of food.) In a few instances, I have gone so far as to have all food weighed out before the child. It is astonishing to see a child who has had to be forced to eat stand around a food scale pleading to have more put on the scale for him to eat.

The most regularly successful method which I have tried is the "alarm-clock stunt." Where it is applied to the proper sort of child, it is almost infallible. The stage is set so that there is nothing in the room but the table, chair, all courses of the meal and an alarm clock set to ring in ten or fifteen minutes. The child is told that there is the meal, that when the bell rings, it will be taken away, and he is then left absolutely alone, preferably with the door closed, until the time is up. Under no condition may any one enter the room during the allotted time. The instant the alarm goes off, the at-

tendant enters briskly, removes the dishes and all uneaten food, sending the child off with no comment. It is always permissible to talk about how much is eaten, but never about how little. One child gained 8 pounds in six weeks on this régime. The great advantage of the alarm clock stunt lies in that it removes parent and nurse from the table.

With such methods, the greatest difficulty lies not in getting a good response from the child, but in continuing the play long enough for the idea that it is desirable to eat to become fixed in the child's mind. For this reason, we must often continue treatment long after the cure is apparent.

It is often advisable to precede any such treatment with a preliminary short period of actual starvation in order that the child may be in a receptive mood physiologically. Reduction, or entire elimination, of milk from the diet during the first week of treatment has lately been almost routine in my cases.

Treatment of Children Who Desire to Be Important.—In treating these children, it is also possible to take advantage of the very factor which has caused the difficulty. When he does eat, make him so important that eating is a real incentive. Pay no attention to poor eating, and in paying no attention to this, be very careful that the child does not realize that you are secretly worried. Children are astute in their diagnosis of adults. One has to guard every word and look. Sometimes, this treatment almost amounts to "kidding them into eating." Give the child only a teaspoonful of cereal and then talk all the rest of the day about how wonderfully he cleaned up his plate and how much he is eating. Tell "Daddy" about it.

It often happens that there is a hidden factor in this kind of child which must not be overlooked. One day, while looking over a new baby, home only a few weeks from the hospital, I was asked to see what was the matter with the older child, who recently had refused all food. Inquiry brought out the fact that this refusal dated from the baby's arrival into the home. Obviously, the treatment of this child required special methods. The 3-year-old had to be made to feel that she was a part of the baby's triumph, that she shared in the mother's ownership of the baby and that she was therefore more important than the baby. Treatment at meal time alone could not cure this case.

In another instance, the difficulty had its onset with the coming of a new nurse. Perhaps the child felt the need of impressing this stranger with her individuality and so she did not eat.

So many different factors are likely to come up in a consideration of this type of child that it is hopeless to try to enumerate them. It is most important that this question be asked, "What happened at the time we first noticed that she didn't eat?" In that way only is it possible to arrive at any illuminating facts as to the underlying cause.

Attempts to Obtain Favors.—When a child definitely tries to obtain favors by rewarding us with eating, where he holds the "big stick" of refusal over our heads, the rational course to pursue is to show him that it does not work. Let him clearly understand that you do not care whether or not he ever eats another mouthful. It is a small matter in your life. The doctor says that it is all right if he does not want to eat. He is the loser, not you. But (and this is not by way of punishment) if he does not eat enough to keep body and soul together, he will have to stay in bed because he will not be strong enough to get around.

In this method of treatment, he not only gets no favors but he loses his liberty. The incentive for refusal is removed.

In the foregoing treatment of these rather obvious factors in the child which lead to his poor appetite, I am oftentimes sympathetic with the child's attitude. This method of treatment is not based on ridicule of his feelings. I am simply pointing out the natural and obvious treatment from the appetite standpoint.

It is fully realized that, in many instances, the child may be right in his desires. He may be justly and hungrily desirous of attention that is not given him in proper amounts. Perhaps he wants the attention of his mother, who leaves him too much in the care of a nurse that he does not like. Perhaps refusing to eat is the only way he has found to satisfy his longing. In many instances, where there is too strict discipline in the family, he too feels the need of having his own way. By accident, he has learned that refusing to eat is a potent method by which he can obtain his desires.

Often, the demands of these children are not wrong; but the method by which they seek to gain their point has produced the appetite problem. This method, since it is harmful to the child, must be made unattractive to him. Emphasis must be placed on the fact that it is often well "to take a tip" from the symptom and to see whether something cannot be done so that the child will not need to use such drastic and unnatural methods.

HEALTH EXHIBITS AT WASHINGTON MEETING

Those in charge of the health exhibits for the Washington meeting are fast completing plans for that exhibit. Several exhibitors have already made their request for space. Since there is not so much available space as would be desired, it is essential that those desiring to exhibit make their intentions known at once.

It is hoped to develop an exhibit which will be of the highest caliber, one which will be attractive, instructive and constructive. To make this possible, every exhibit must come up to those requirements, and each must have an attendant in charge at all times. This will demand early planning, so file your request for space immediately. Send this request to:

Dr. G. H. Wandel, *Supervisor,*
Bureau of Dental Health Education,
58 E. Washington St.,
Chicago, Ill.

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

Speech Defects: Under the title "Is the Treatment of Speech Disorders a Medical Problem?" J. A. Glassburg (*J. A. M. A.*, March 23, 1929) discusses the etiology of various speech defects and treatment therefor, with illustrative cases. Of cleft palate and harelip in these speech defects, he says: "When the palate is open, the rear passage of the air through the nose cannot be shut off and all the sounds except m, n and ng are changed in quality and character. The vowels assume a nasal twang, and a snorting speech is the result. Harelip is closely associated with cleft palate and is found together with it. Surgical intervention is indicated whenever possible. This is to be followed by speech reeducation." Under "Deformities of the Jaws and Dental Arches," he says: "Prognathism of the jaw is a very common cause of lisping. The correct form of the dental arches and the proper occlusion of the teeth are necessary for the pronunciation of certain sounds, particularly s, which becomes sh when the upper teeth protrude too far beyond the lower ones. When, because of marked prognathism, the lips do not meet in juxtaposition, there is difficulty with the letters f, v, p, b and m. Another not infrequent cause of incorrect and indistinct pronunciation is rigidity of the jaw. The voice does not carry, speech is unintelligible and there is mouthing of the sounds. The modus operandi of this is appreciated when it is realized that to the lower jaw are attached the muscles of the tongue and the hyoid bone. The larynx is connected with the hyoid bone; thus the rigidity of the jaw influences the mouth and larynx. The treatment of these cases is primarily within the scope of the dental surgeon and orthodontist. Prophylaxis and dental hygiene can do much to preserve the normal state of the teeth and thus prevent the unnecessary development of these particular speech disorders." Of the teeth, he says: "The teeth, because of their firm attachment, have a passive rôle in articulation, but this rôle is very important. Though the teeth themselves do not make any active obstructive movements to the clear passage of the breath, their very presence is a hindrance to it. Great protrusion of the upper teeth makes s sound like sh. Dental gaps affect the production of s. A bent inward canine tooth interferes with the t sound, giving it an s quality. Undershot jaws affect the sounds f, v, p, b, m, w, wh, oo, a and o. Overshot jaws affect all these sounds plus the sounds th, soft and hard, s, sh, t, ch, z, zh, d and j. An open bite affects all the sounds with the exception of the open vowels, the nasal ng and the aspirate h. Obtruded front teeth interfere with the sounds f, th, soft and hard, s, sh, z, v, zh, wh, p, oo, o, w, b and a. Intruded front teeth interfere with the sounds th, soft and hard, s, t, z and d. I believe that I have given sufficient instances of the importance of their rôle of articulators to demonstrate the necessity of dental examination in cases of defective phonation. Most of the abnormalities can be easily cured by orthodontia."

Electrothermic Treatment of Oral Neoplasms: Twenty years of intensive study and experience have demonstrated to me that malignant disease within the mouth and adjacent parts, while always a most serious affection, is not necessarily hopeless, since many brilliant results are obtained by the judicious employment of combined methods, of which electrodessiccation and electrocoagulation are most important; indeed, are, on pure merit, entitled to hold first place in treatment of primary lesions. Operative surgery is also considered indispensable, and is constantly employed by me to ligate blood vessels and to resect bone. In certain instances, cervical lymph nodes are surgically resected, but never before the malignant element has been inhibited, or, when possible, entirely destroyed by preoperative irradiation treatment. A gastrostomy is often performed to insure proper feeding in undernourished patients,

owing to difficulty in deglutition before the operation and during the convalescent period. Many radical electrothermic operations have been rendered possible by this preliminary gastrostomy. Operative surgery has a still greater field of usefulness in cancer involving other parts of the body. Radium and roentgen rays are used in my practice in connection with neoplasms in the locations under consideration principally to control metastasis to the cervical lymph nodes, and their value for this purpose has been definitely established. The primary lesions are, with certain exceptions (cases in which vital structures or those very important to conserve are involved) best treated by the electrothermic methods and I have had no cause to regret this practice after critical comparison of results of different methods in many cases.—William L. Clark, in *Am. J. Surg.,* March, 1929.

Electrosurgery: In a discussion of the advantages of electrosurgery in the destruction of pathologic tissue, Edwin N. Kime (*New England J. Med.,* March 14, 1929) tabulates a series of 100 private cases with seventy-five cures, after one year or longer, and reports in detail two cases of extensive malignancy with satisfactory results. In one case, in a woman, aged 67, there was an ulcerated, infected cauliflower mass involving the entire nose, a portion of both cheeks, the nasion and the upper lip. Efforts at treatment, with a fulgurating current, roentgen ray and radium, over a period of five years, during which the growth increased from a verrucous patch on the side of the nose to its present size, were all failures. Palliative removal by electrosurgery was advised, and the entire mass was excised. A month later, a second operation was performed and skin grafts were applied. There has been no recurrence in more than two years. In the second case reported, in a man, aged 72, there was an epithelioma of the cheek of three years' duration, involving the upper and anterior portion of the parotid gland, Stenson's duct and the middle radicles of the facial nerve. The patient complained of trismus and pain, following the use of arsenic paste on two occasions. Electrocoagulation and excision completely relieved the pain. The wound healed in eight weeks and there has been no recurrence in more than a year. The author concludes: 1. Electrosurgery is a valuable adjunct in certain selected cases, particularly in premalignant and malignant neoplasms and the various infective granulomas. 2. Electrosurgery properly administered requires first of all good surgical judgment and operative skill, and secondly a sound and practical knowledge of the scientific principles underlying the technic of application of the various types of damped and undamped oscillatory high frequency currents for electrothermic destruction of pathologic tissues.

Foreign Body in Cheek: The following case is reported by F. S. Balyeat (*California and Western Med.,* February, 1929): A young Mexican, one year previously, had had the right lower third molar extracted under procain. Several weeks later, there was marked swelling of the right side of the face and, one week later, spontaneous rupture opposite the second lower molar. The sinus discharged pus for several months and did not heal in spite of curettement. Roentgenograms were reported negative for osteomyelitis or foreign body. About nine months after the extraction of the tooth, the patient could not open his mouth more than one-half inch. Probing of the sinus led to the mandible. Films were still negative for osteomyelitis. A Wassermann test, urinalysis and pus smears were negative and the blood count was normal. A series of roentgenograms taken higher on the ramus revealed a misplaced molar near the coronoid process, lying over the anterior border of the ramus in the soft tissues. The tooth, when removed, was found to be a typical lower molar showing extensive necrosis on one side of the roots. The mouth wound healed and a few weeks later the sinus ceased to discharge and was closed. It is the author's belief that this was a misplaced tooth rather than a supernumerary molar, and that it was acting as an infected foreign body.

FOREIGN LITERATURE

Deep Overbite and Its Prevention (A. M. Schwarz, Ztschr. f. Stomatol., 1929, No. 1, p. 1): Among the many classic contributions of A. M. Schwarz to orthodontic problems, this is one of the most remarkable. Schwarz proves that the finer masticatory mechanism of the teeth in the incisor region is not to be compared with the function of scissors. It is a grinding mechanism just as that of the teeth in the molar region. There can be a division between a "balancing incisor overbite" and the "bearing incisor overbite." If we have a "balancing overbite," the masticating muscles are led to a function in which a

favorable physiologic grinding down of all teeth occurs. The "bearing overbite" brings about a masticatory function in which the normal mesial growth of the mandible is disturbed. It is often said that the modern man does not use his teeth and jaws properly. This is true, just as it is true of other organs of the body. Disuse of organs in life is corrected by gymnastic exercise. The same sort of exercise is to be done with the jaws. A forward gnashing drill, as Schwarz writes, fills a void in the present day physiology of the human teeth. This "forward gnashing drill" has its primary importance between 5 and 14 years of age. It is to be done by pushing the lower jaw forward until the front teeth are in alinement. This must be done 100 times three times a day, with the jaws pressed together. Children soon accustom themselves to such an exercise. The drill prevents a bearing incisor overbite and other deformities of this kind. The exercise should not be overdone, and it is not recommended as necessary for adults. Rogers is complimented as the founder of orthodontic jaw gymnastics.

BALINT ORBAN, Chicago.

Peculiar Congenital Inclination in Excessive Growth of the Nasal Septum and Premaxilla (H. Pichler, Ztschr. f. Stomatol., 1929, No. 1, p. 21): With reference to the paper of Schwarz (see above), in the same magazine Professor Pichler describes cases of cleft palates where the premaxilla and nasal septum have grown much greater in length than the side of the jaw. The author discusses the possibilities of an hereditary origin of the bearing overbite. The forward gnashing drill of Schwarz is recommended.

BALINT ORBAN, Chicago.

Root-Canal Technic—An Analysis Based upon a Survey (Louis I. Grossman, Zahnärztliche Rundschau, 1928, Nos. 45 & 46): The author describes the different instruments required in proper root-canal treatment. Mechanical cleaning of the canal is important. It is also important to use different drugs, acids and alkalis, the former to dissolve the inorganic substances, the latter to remove organic substances. Disinfecting agents must be employed to sterilize the infected canal. The author does not describe his own methods or his experiences. The paper, as indicated in the title, is a survey of the literature.

BALINT ORBAN, Chicago.

Diseases of the Periapical Tissue (Von Erich Feiler, Fortschr. d. Zahnheilk., No. 5, 1928, p. 383): Recently, more experimental work has been undertaken to show the effects on the periapical tissues of drugs used in root canals. R. Weber, in studying the effects of arsenic, concluded that the well-known round-cell infiltration of the periapical tissues was secondary to the inflammatory reaction found in the pulp. Balters, on the contrary, was able to show necrotic changes which he concluded were due to direct action of the arsenic. O. Müller conducted a series of experiments on dogs in which he used all of the drugs commonly employed in the treatment of root canals. In every instance, it was possible to show changes such as inflammation, round cell infiltration, bone changes and necrosis. The least changes were produced when Albrecht's root-canal filling materials were used. The most extensive changes were brought about when eugenol was employed. Tricresol-formalin (40 per cent solution of formaldehyd) brought about marked disturbances also. It is interesting to note that, while the Albrecht filling contained formalin in a gelatinous paste, Müller found it the least irritating of all used. Feldmann, on the contrary, concludes that formalin used in pastes always acts detrimentally. He obtained the most favorable results with thymol and eugenol used together. The experiments of Hübner on monkeys showed favorable results with Gysi's triopaste. The drugs used by all of these investigators showed marked differences, but all produced periapical changes of varying degrees. At the present time, it is difficult, upon the basis of these animal experiments, to draw conclusions that could justly be carried over into practice. Clinical results contradict these findings. Millions of teeth have been treated with eugenol as well as tricresol-formalin and have remained in the mouths for years without showing the destructive changes that have been brought about in animal experimental work.

EMIL MUELLER, Chicago.

Diseases of the Pulp (Von Wolfgang Praeger, Fortschr. d. Zahnheilkunde, No. 5, 1928, p. 363): The pathology of the pulp differs from the pathology of other tissues in two respects: (1) The pulps react rather violently to comparatively small injuries, and (2) the pulps in healthy as well as diseased conditions are capable of developing hard substances. Among the hard substances de-

veloped is secondary dentin. It is of clinical significance because it is deposited as a protective measure. Mild forms of irritation bring about a deposit of secondary dentin. Whether or not the practitioner can bring about the development of secondary dentin regularly is questionable. General systemic diseases can influence the pulp. This has been proved conclusively by Kotanyi in experiments with scurvy in animals. Mild grinding on the teeth produced marked changes of the pulp, among them hyperemia and vacuole degeneration of the odontoblasts. To the question, "Can exposed pulps be saved?" an answer based upon the work of Peckert, Rebel, Grabbe, Palazzi and the author is that it is useless to attempt it.

EMIL MUELLER, Chicago.

Root Filling Methods (Von Erich Feiler, Fortschr. d. Zahnheilk., No. 6, 1928, p. 490): The question as to whether pulps should be amputated or extirpated has again been revived because of recent systematic investigations of O. Müller. He believes it absolutely essential that the root-canal filling be brought into close contact with the remaining pulp tissues. He also believes that it is never possible to remove all of the pulp tissues from the canal. To test the validity of these conclusions, he undertook a series of experiments upon the basis of which it was possible to show that pulps do not always tear away at the foramen as has been quite universally taught in the past; that pulps may tear away well within the pulp canals often at the turns; that frequently the pulp tears away well outside of the canal, bringing some of the periodontal membrane with it; and that pulp tissue from lateral canals can never be removed. The author concludes, upon the basis of his experiments, that the contentions of Müller are unsound. He believes that pulps can very frequently be removed to the foramen even though the broach cannot reach the foramen. Very frequently, it is possible to remove pulps with many fine branchings even from lateral canals. O. Müller extirpated and amputated a series of pulps for experimental purposes. Roentgen-ray pictures from 195 teeth so treated were analyzed as follows: Extirpation: satisfactory, 80 (57.5 per cent); unsatisfactory, 59 (42.5 per cent). Amputation: satisfactory, 49 (87.5 per cent); unsatisfactory, 7 (12.5 per cent). These figures are contrary to the author's as well as all other clinicians' findings. He observes annually about 1,500 extirpated pulps and filled roots in which the percentage of successful cases is decidedly higher. For the present, if it becomes necessary to choose between extirpation and amputation, extirpation is the author's choice.

EMIL MUELLER, Chicago.

Sebacious Glands in the Mouth (K. Peter, Vierteljahrsschr. f. Zahnheilk., 44, No. 3, 1928, p. 435): The mucous membrane of the mouth, like the skin, though principally intended to act as an integument, is, in certain areas, developed into special structures. The mucous membrane of the tongue has its taste buds and raphae; the mucosa of the buccal vestibule and soft palate is rich in mucous glands; and that of the gingivae is hard and tough and absolutely devoid of glands or other special organs, being analogous to the hornified skin of the palms of the hands and soles of the feet. Sebacious glands (secreting fat and tissue cells), though normally skin structures, are found in the mouths of 30 per cent of adults according to this author, but never in the mouths of children. Yellowish white and varying from 0.2 to 2 mm. in diameter, they occur mostly on the lips and lining of the cheeks in triangular masses or encircling the papilla of Stenson's duct. Also, they are occasionally found on the soft palate, and the retromolar fossa and between the pillars of the fauces. Persons troubled with whitish, gummy mucous deposits on the lips and in the corners of the mouth should be examined for the presence of these glands. Their detection is facilitated by stretching the mucous membrane. Although this condition was first described by Fordyce in 1896 and is known as Fordyce's disease, Dr. Peter, desirous of a more descriptive and latinized name, suggests *seboglandia buccalis.* As it often takes the form of yellow nodules, care should be exercised not to confuse the condition with tuberculosis of the mouth. Several very clear histologic slides and two color plates illustrating the condition in the mouth accompany the article.

JAMES D. FRANKEL, Chicago.

Introduction to a Paper on Periodontal Pyorrhea and Alveolar Atrophy (B. Gottlieb, Fortschr. d. Zahnheilk., No. 5, 1929): Occasionally signs of displeasure become apparent in the ranks of the practitioners over the fact that, on the one hand, the scientists dispute so much with each other, and manifestly all are wrong; and, on the other hand, frequently, only with great effort, can the mea-

ger practical results be gained from the "scientific ruins." Such points of view are short-sighted.

Undisturbed peace is to be found only in the grave. When no differences of opinion exist, it by no means indicates that a definite goal is reached. Neither does the common but erroneous opinion prove that where the greatest differences of opinion reign, the uncertainty is the greatest. We must realize that progress is not always made when some one comes out with something new. We are all human, and must be mindful of the fact that we ourselves can err as well as fall into the errors of others. Everything new must prove itself true in the struggle against criticism and experience before we can rejoice in its enduring possession. Therefore, whenever a heated controversy breaks out concerning any kind of innovation, no one should regret the energy which is apparently squandered on it. The impartial onlooker, moreover, must say to himself: "Tua res agitur." The more intense the controversy becomes, the more firmly founded will be the final results. Everyone must concern himself with searching out the subject under consideration in the most scientific manner in order to arrive at new arguments. Every one should gain from his material the utmost and thus contribute to the finding which will lead to a solution. The onlookers in such a controversy have accordingly every reason not to lose patience, but should rather rejoice in the conviction that their interests are being presented conscientiously.

There are groups that say, "All honor to that! But the different phases of the controversy do not interest me. It is a waste of time to read such things. I am going to wait until the controversy is settled, and will direct my attentions to the results which will be brought forth." This reasoning also is faulty. The results of such discussions will not be made known through advertising but will rather become known during the course of the discussion. Generally, it takes a long time before the true results of a scientific controversy find their way into the textbooks. From sheer overcautious waiting, often for a long time, nothing is learned of the most important developments. The overcautious become antiquated, while the alert keep thoroughly up to date.

Previous professional knowledge does not necessarily belong to the pursuit of scientific questions. A natural human understanding frequently plays a decisive rôle. Fundamental knowledge we gain during the course of the controversy by observing the findings in research. In this manner, every one can form his own opinion. This fact has a far-reaching practical significance. By following the discussions on different subjects, one will be able to develop his own judgment and therefore not be dependent for knowledge on one-sided information.

The pursuit of controversies on important questions also has an additional advantage. In order to save time and energy, some would like to absorb the gist of the matter somewhat as one studies the answers to questions for examinations. One can easily be convinced that such a method of saving energy is bad. The value of a rule lies in the exception. Laws can be correctly followed only when one knows their exact motives, and these must be intelligently studied and not crammed. One remembers a law much more easily and knows its application much more specifically when one has followed intelligently its discussion and its reasons pro and con.

The too often noticeable struggle to separate the "useless scientific ballast" from the practical and "worthy" as one separates the chaff from the wheat has failed entirely from the practical point of view. On closer scrutiny, it is clear that there are absolutely no theoretical questions in the special disciplines which would have no more or no less significance in practice. Practitioners who guard themselves so anxiously from taking any ballast should not be surprised when they find themselves "outdone" in many questions. We continually hear that this or that colleague seeks spiritual stimulation for his recreation in fields which lie entirely outside his own profession. For the most part, these are the same groups which, with special cunning, consciously refuse the purely theoretical questions in their own fields. If these men would develop more interest in their own subjects, their longing for spiritual stimulation would be satisfied, and further than that, they would be assured of reaching their goal in a much more practical way.

For all these reasons, I consider a broad discussion of important theoretical questions as excellent, in the conviction that the cultivation of knowledge is of just as high a practical significance for the fundamental knowledge as the plan of the construction of an instrument is for the facility of handling it.

EMIL MUELLER, Chicago.

MISCELLANY

BOOK REVIEWS

Dental Anatomy. Classroom and Laboratory Quiz Compend. By William C. Stillson, D.D.S., Associate Professor of Dental Anatomy, Western Reserve University, Dental School, Cleveland, Ohio. 280 pages; cloth, price $2.25 net. Published by W. B. Saunders Company, Philadelphia and London.

This quiz compend is complete, with questions and answers on almost every conceivable phase of the subject. The author takes as his guide in definitions such standard works as Black's Dental Anatomy, Broomell and Fischelis' "Anatomy and Histology of the Mouth and Teeth," Noyes' "Dental Histology and Embryology," Dewey's "Dental Anatomy," and other works.

Dr. Stillson has expended a great deal of effort in preparing this book and is entitled to the thanks of students and all those who wish to review the subject in a condensed form. It is a book that one may study as profoundly as possible, or may pick up at odd moments to brush up on the subject at will.

Outlines of Dental Science. Volume X. Dental Histology. By Alexander Livingston, M.D.S., M.B., Ch.B. (Liv.), L.D.S., R.C.S. (Eng.) Consulting dental surgeon to the London County Council; honorary dental surgeon, Royal Eye Hospital, London; director of dental studies and sub-dean, King's College Hospital Dental School; lecturer in dental surgery, University of London; formerly demonstrator of dental histology and pathology, in the University of Liverpool, etc., etc. Illustrated. 143 pages. Price, $2.50. Published by William Wood & Company, 51 Fifth Avenue, New York, and E. & S. Livingstone, 16-17 Teviot Place, Edinburgh.

This small volume is another of the Outlines of Dental Science, which have been appearing from time to time. It is not intended by the authors or publishers that these books are to cover the detailed description of the various tissues, but they are of particular value in reviewing the subject and for ready reference in the routine of practice. It is a pleasure to mention the very excellent stock and presswork that the publishers have put into this book.

CORRESPONDENCE

To the Editor: Will you kindly give space to this communication? Just before Christmas I learned that the sale of seals was only a little greater than at the same date the year before. Personally, I felt that all our members should, and would, purchase these seals, except that the peculiar characteristic of our profession seems to be procrastination. Hence, I wrote an editorial appeal, which appeared in the *Dental Items of Interest* for January, urging those who had "forgotten" to "remember" and to send me a check. I asked that the checks be sent to me because I was curious to see what sort of response we would have.

The result has been rather peculiar, and with your permission, I would like to report this in our official organ, where all may see it.

Of course I asked for only the usual dollar that pays for a package of seals. Replies and checks came in from the following, the amounts being one, two or three dollars: Frank Brandreth, Royersford, Pa.; G. M. Frazier, Quantico, Va.; Benjamin S. Hall, Brooklyn, N. Y.; J. Lowe, Rolling Fork, Miss.; L. P. Niemeyer, North Hollywood, Calif.; W. G. Neal, Abilene, Texas; Samuel Mohr, Brooklyn, N. Y.; H. L. Wille, San Antonio, Texas; S. Waterman, Brooklyn, N. Y.; F. Zacharoff, Brooklyn, N. Y.; A. C. Rahe, Aurora, Ind. The total from these gentlemen amounts to $17.00.

An odd circumstance is that, on January 10, James F. Moon, of East Orange, N. J., because he had "forgotten" sent a check for $3.00, and then he must have "forgotten" that he had sent it, because, on February 19, he sent a second check for the same sum. With the last, he included a slip reading: "With love for all men, but in this case for all old and sick dentists." This may serve as a hint or suggestion to others who have forgotten the Relief Fund, that it is not yet too late to "remember."

R. W. Taggart of New York City sent $5.00, and B. Rosenberg of the same city, $10.00.

A few quotations from letters received may be interesting and perhaps suggestive. Dr. Niemeyer of North Hollywood sent a check for $2.00, because, "I have been out for two years." How many more will send me a dollar a year for every year they have "been out"? This example should not be lost. Similarly, Dr. Wille writes that, after reading the editorial, he "remembered" that he had "forgotten" and therefore sends "a self imposed fine of 100 per cent."

Lastly, here are two letters that should make every member of the American Dental Association "think." Dr. Adolph Salgo of Philadelphia, Pa., writes:

"I am not a member of the A. D. A., but after reading your editorial, I could not help but offer you my modest contribution ($2.00)."

Lastly, the following from our neighbor to the North, Walter G. Kennedy of Montreal, Canada:

"I hope you will not refuse Canadian money to help your good work. As Tiny Tim said, 'God bless you every one.'"

Special thanks I think are due to our American nonmember and to our Canadian brother.

The total of the subscriptions herewith acknowledged amounts to $65.00. With gratitude to all,

R. OTTOLENGUI, *Chairman,*
Dental Relief Commission

P. S. I find that I was mistaken about Dr. Moon of East Orange. He has never "forgotten." On the contrary, he has a splendid memory, because, just as I was about to mail this (March 25, to be exact), Dr. Moon "remembered" the Relief Fund again, and sent in another check, bringing the final total to $68.00. Three dollars a month for three months. Would it not be just splendid if about 10,000 of our members would follow that wonderful example? Three dollars a month, or two dollars, or one dollar, or even fifty cents a month from ten or twenty or thirty thousand of us. Think of the happiness that would buy. Makes those who "forget" to send even one dollar a year—well, it *should* make them think a bit.—R. O.

COMMITTEE ON THE COST OF MEDICAL CARE

A committee on the cost of medical care has has been created and its chairman, Dr. Ray Lyman Wilbur, explains in this foreword in the bulletin issued by this organization that:

"The Committee on the Cost of Medical Care has been created to study a problem which, according to the secretary of the American Medical Association, is the one great outstanding question before the medical profession today: 'the delivery of adequate, scientific service to all the people, rich and poor, at a cost which can be reasonably met by them in their respective stations in life.'"

The foregoing question relates to the dental profession as well, and the Trustees of the American Dental Association have appointed a dental committee to cooperate in the above mentioned study.

This dental committee desires to secure data collected by individuals or groups relating to the economic aspects of dental service, such as cost of education, equipment, material, rent, heat and light, also the dentist's income, gross and net. Any one having any such material will greatly assist the committee in formulating its plans if they will send these data to Harold J. Leonard, Dental Dept., Columbia University, 830 W. 168th St., New York City.

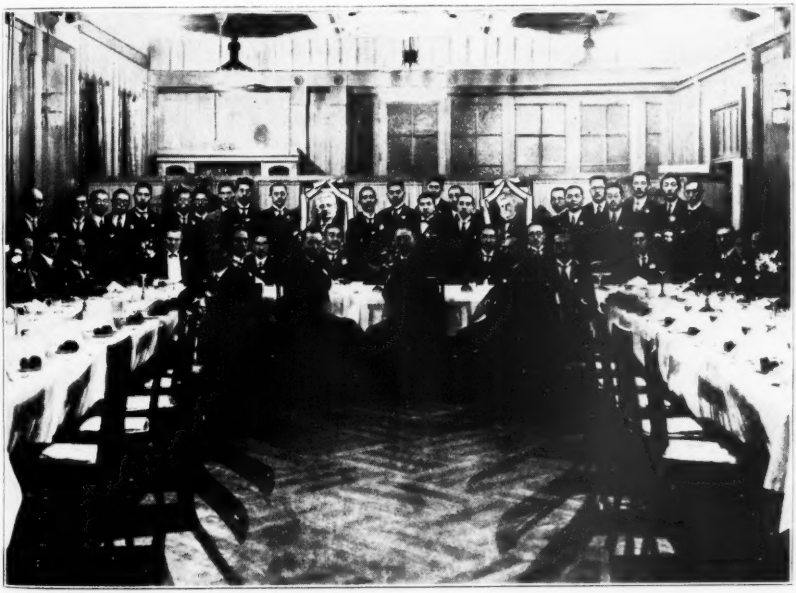
HERBERT E. PHILLIPS, *Chairman,*
Committee on Cost of Dental Service, A.D.A.

NEWS

Rochester Dental Dispensary Report: The Annual Report of the Rochester Dental Dispensary for 1928, by the director, Harvey J. Burkhart, has just been issued. A study of this report reveals the great amount of service given to the citizens of Rochester annually, and it is illuminating to note what is being accomplished through the medium of Mr. Eastman's philanthropy. Those interested may secure a copy of the report by writing to the Rochester Dental Dispensary, Rochester, N. Y.

Memorial Services in Tokio for Drs. Brophy and Peeso: A memorial service was held in Tokio, December 16, by the Nippon Dental Prosthetic Society and the Japanese Alumni Association of the Chicago College of Dental Surgery in honor of the late Truman W. Brophy and the late Frederic A. Peeso. Resolutions were passed acknowledging regrets at the passing during the current year of these "two great American teachers and practitioners of the dental profession." The report of this memorial service continues: "These resolutions are sponsored and adopted by those members

who have had the benefit of the personal guidance and training of these great teachers at the schools in which they taught and by the members at large, to whom the achievements and noble character of these outstanding figures have given inestimable animus and inspiration in the practice of their profession." The resolutions are signed for the Nippon Dental Prosthetic Society by Mitsuru Okada, D. D. S., President, and Naoshige Irimajiri, D. D. S., Secretary, and for the Japanese Alumni Association of the Chicago College of Dental Surgery by Keyohei Goto, D. D. S., President, and Teiryo Aoki, D. D. S., Secretary, and also by Watari Kawai, D. D. S., Chairman of the Meeting.



Memorial service held in Tokio for Drs. Brophy and Peeso.

Nebraska Passes Bill Regarding Requirements for Dental License: The Legislature of Nebraska recently passed Senate File No. 162 "A bill for an act to amend Section 84 of Chapter 167 of the Laws of Nebraska for 1927, providing for the acceptance of the certificates of those passing the National Board of Dental Examiners in lieu of an examination before the Nebraska State Board of Dental Examiners, and to repeal said original section. Be it enacted by the people of the State of Nebraska:

"Section 1. That Section 84 of Chapter 167 of the Laws of Nebraska for 1927 is hereby amended to read as follows: Section 84. Every applicant for a license to practice dentistry shall: 1. Furnish proof of having completed a four year course in an accredited high school or its equivalent, as that term is herein defined. 2. Present proof of graduation from an accredited school or college of dentistry. 3. Pass an examination prescribed by the Board of Examiners in dentistry which shall be elementary and practical in character, but sufficiently thorough to test the fitness of the candidate to practice dentistry. Said examination shall include questions on anatomy, physiology chemistry, materia medica, therapeutics, metallurgy, histology, pathology, oral surgery, operative and prosthetic dentistry, hygiene and dental jurisprudence, and such other subjects as are usually found in the

curriculum of a dental college. Demonstrations of the applicant's skill in operative and prosthetic dentistry shall also be required and a grade of eighty-five per cent shall be attained therein. 4. *The department shall accept upon the recommendation of the State Board of Dental Examiners in lieu of the examination herein provided a certificate of examination issued by the National Board of Dental Examiners of the United States of America; but every applicant for a license upon the basis of such certificate shall be required to pay the fees prescribed for licenses issued in dentistry without examination based upon a license by examination held by another state, territory, or District of Columbia."*

Section 2. That said original Section 84 of Chapter 167, Laws of Nebraska, 1927, is hereby repealed."

Body of Girl Long Missing Identified by Dental Work: The body of a Smith college girl, missing for more than one year, was positively identified when records kept by her family dentist of work done on her teeth were brought into the case. Identification by other means was impossible as the body had been in the river from which it was recovered for so long that all other possible means of identification were destroyed.

Georgia Dental Hygienists Meet: The first annual meeting of the Georgia Dental Hygienists Association was held in Atlanta, March 12. H. M. Garvin, of Winnipeg, Canada, gave a clinic and paper. The next meeting will be held in conjunction with the Georgia State Dental Association meeting in June, 1930. J. Russell Mitchell, of Atlanta, is a newly elected member of the board of advisors for the hygienists.

Dental Education by Life Insurance Company: The Metropolitan Life Insurance Company of New York, in an effort to educate the public as to the importance of good teeth to good general health, has published a flyer entitled "Two Sets or Three?" stressing the importance of maintaining the temporary teeth in the mouth throughout their natural life, the value of the first permanent molars to the dental arch, building good teeth through attention to diet and the need for dental care throughout the life of the teeth.

Dental Laws: The following summary of dental license requirements throughout the world, July 31, 1928, has been compiled by Alphonso Irwin of Camden, N. J.:

The work accomplished during the month of July, 1928, in answering questions concerning dental laws and license regulations touched upon four continents and an island continent; namely, Australia, including Canberra, F. C. T., and New South Wales; also, the following states, provinces, countries and islands located within the four continents: California, Canada (Province of Ontario), Chili, England, Germany, Grenada, Holland, Java, Mexico, Missouri, Netherlands, Switzerland, the United States (entire), Union of South Africa (Transvaal) and Wyoming. Arizona and New Jersey should be added thereto, by telephone calls and personal visits of dentists seeking information about dental laws.

The new dental laws of the Windward Islands (Grenada), the National Code Regulating the Professions in Mexico (Codigo Sanitario), which includes the dental requirements, the dental regulations of the Cantons of Switzerland, the new "Consolidating and Amending Act of the Union of South Africa," in force in the Union on January 1, 1929, "relating to Medical Practice, Dentists," etc., and to provide for the extension of this act to the mandated territory of Southwest Africa, were also received during this month.

During the last few years, 110 dental laws printed in twenty languages have been more or less changed out of 159 acts regulating the practice of dentistry in 300 commonwealths throughout the world, by new legislation readjusting legal requirements for dentists.

This represents the result of only one month's efforts. Multiply it by twelve, and you gain a faint idea of the character, extent and far-reaching effects of the work.

Deaths

Brown, Clarence E., Omaha, Nebr.; Kansas City Dental College, 1896; died, March 2; aged 59.

Campbell, Bertram Clark, Madison, Wis.; Chicago College of Dental Surgery, 1892; died, January 10; aged 60.

Greene, Frank A., Geneva, N. Y.; died, March 13; aged 73. Dr. Greene had practiced in Geneva for forty-seven years.

Jones, Treve, Portland, Ore.; North Pacific College of Oregon, School of Dentistry, 1907; died recently of heart disease; aged 48.

Knapp, Ernest L., Chicago, Ill.; Chicago College of Dental Surgery, Dental Department of Loyola University, 1890; died, February 22; aged 63.

Logan, D. D., Milwaukee, Wis.; Marquette University Dental School, 1902; died recently, aged 48.

Lowrie, Walter E., Tacoma, Wash.; Chicago College of Dental Surgery, Dental Department of Loyola University, 1903; died recently, after an operation.

Newbury, Horace E., Burlington, Wis.; died recently; aged 57.

Palmer, James L., East Moline, Ill.; Chicago College of Dental Surgery, Dental Department of Loyola University, 1892; died, January 1; aged 74. Dr. Palmer suffered a stroke of paralysis in November, 1928.

Prothero, James Harrison, Chicago, Ill.; Missouri Dental College (Washington University), 1890; died suddenly, April 8.

Williard, Eugene Shaw, Chicago, Ill.; Northwestern University School of Dentistry, 1899; died of appendicitis, March 29; aged 72. Dr. Williard was professor of bacteriology and dental pathology at Northwestern University.

ANNOUNCEMENTS

CALENDAR OF MEETINGS*

NATIONAL SOCIETIES

American Dental Association, Washington, D. C., Oct. 7-11, 1929.

American Dental Assistants Association, Washington, D. C., Oct. 7-10, 1929.

American Full Denture Society, Washington, D. C., Oct. 1, 1929.

American Society of Orthodontists, Estes Park, Colo., July 15-19, 1929.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June inclusive.

May (1929)

Arkansas, at Little Rock (20-22).
Illinois, at Springfield (14-16).
Indiana, at Indianapolis (20-22).
Iowa, at Cedar Rapids (7-9).
Maryland, at Baltimore (6-8).
Massachusetts, at Boston (6-10).
Missouri, at St. Joseph (12-14).
Nebraska, at Omaha (20-23).
New York, at Rochester (15-17).
North Dakota, at Grand Forks (14-16).
Pennsylvania, at Scranton (14-16).
Southern California, at Los Angeles (6-7).
Vermont, at Burlington (22-24).
West Virginia, at White Sulphur Springs (27-29).

June (1929)

Colorado, at Colorado Springs (17-19).
Georgia, at Atlanta (12-14).
Maine, at South Poland (20-22).
Michigan, at Detroit (18-20).
Nevada, at Reno (1).
North Carolina, at Wrightsville Beach (10-12).
Wyoming, at Cheyenne (28-29).

July (1929)

California, at San Francisco (8-12).
Oregon, at San Francisco (8-12).
South Dakota, at Rapid City (1-2).
Utah, at San Francisco (8-12).
Washington, at San Francisco (8-12).
Wisconsin, at Milwaukee (9-11).

American Dental Society of Europe, London, England, July 29, 1929.

Dental Congress of Latin America, Rio de Janeiro, Brazil, July 14-21, 1929.

International Dental Federation, Utrecht, Holland, Aug. 5-11, 1929.

Pacific Coast Dental Conference, San Francisco, July 8-12, 1929.

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Arizona, at Flagstaff, beginning July 29, 1929. Eugene McGuire, Secretary, 420 Security Bldg., Phoenix.

Arkansas, at Little Rock, June 24. Floyd P. Travis, Secretary-Treasurer, Osceola.

Connecticut, at Hartford, June 27-29, 1929. Arthur B. Holmes, Recorder, 80 Central Ave., Waterbury.

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

Indiana, at Indianapolis, June 17, 1929, J. M. Hale, Secretary-Treasurer, Mt. Vernon.

Delaware, at Wilmington, June 19-20. W. S. P. Combs, Secretary, Middletown.

District of Columbia, at Washington, week beginning June 17. C. Williard Camalier, Secretary-Treasurer, 406 Medical Science Bldg., Washington.

Iowa, at Iowa City, May 27-30. H. D. Grefe, Director, Capitol Bldg., Des Moines.

Kentucky, at Louisville, June 7-11, 1929. Robert L. Sprau, Secretary, 970 Baxter Ave., Louisville.

Maine, at Augusta, June 24-26, 1929. G. W. MacKay, Secretary, Millinocket.

Massachusetts, at Boston, June 11-15, 1929. W. Henry Grant, Secretary, Room 146 State House, Boston.

Michigan, at Ann Arbor, June 10-15. J. W. Lyons, Secretary, 617 Dwight Bldg., Jackson.

Minnesota, at Minneapolis, June 18. F. E. Cobb, Secretary, 601 Donaldson Bldg., Minneapolis.

Mississippi, at Jackson, June 18. T. Ford Leggett, Secretary-Treasurer, Laurel.

Missouri, at Kansas City, June 5-8. George E. Haigh, Secretary, Central Trust Bldg., Jefferson City.

Montana, at Helena, July 8-12. T. P. Regan, Secretary, Helena.

New Jersey, at Trenton, June 24-29, 1929. John C. Forsyth, Secretary, 148 West State St., Trenton.

New Mexico, at Las Cruces, beginning June 13. J. J. Clarke, Secretary, Artesia.

North Carolina, at Raleigh, June 17-20. H. L. Keith, Secretary-Treasurer, 409 Murchison Bldg., Wilmington.

North Dakota, at Fargo, July 9-12. Gilbert Moskau, Secretary-Treasurer, Grand Forks.

Oklahoma, at Oklahoma City, June 24. Charles A. Hess, Secretary-Treasurer, Idabel.

Pennsylvania, at Philadelphia and Pittsburgh, June 27-29, 1929. Alexander H. Reynolds, Secretary, 4630 Chester Ave., Philadelphia.

Rhode Island, at Providence, June 25-27. Albert L. Midgley, Secretary, 1108 Union Trust Bldg., Providence.

South Dakota, at Sioux Falls, June 24. G. G. Kimball, Secretary, Mitchell.

Tennessee, at Memphis, June 17. F. W. Meacham, Secretary-Treasurer, 911 Hamilton National Bank Bldg., Chattanooga.

Texas, at Dallas, June 18-21. Maxwell C. Murphey, Secretary, King's Daughters Hospital, Temple.

Virginia, at Richmond, beginning June 11. John M. Hughes, Secretary, 715 Medical Arts Bldg., Richmond.

MICHIGAN STATE BOARD OF DENTISTRY

The Michigan State Board of Dentistry will hold its next regular examination for the purpose of licensing dentists and dental hygienists to practice in Michigan, June 10-15, at the Dental College of the University of Michigan, Ann Arbor. Applications must be on file in the secretary's office thirty days before the date of examination. For further information, address,

J. W. Lyons, *Secretary,*
617-21 Dwight Bldg.,
Jackson

PENNSYLVANIA STATE DENTAL SOCIETY

The Sixty-First Annual Meeting of the Pennsylvania State Dental Society will be held at Scranton, May 14-16, 1929. Leslie Waddill, Jenkins Arcade, Pittsburgh, is manager of exhibits.

C. W. Hagan, *Secretary,*
1011 Macon Ave., Swissvale P. O.
Pittsburgh

TENNESSEE BOARD OF DENTAL EXAMINERS

The Tennessee Board of Dental Examiners will meet at 9 a. m., June 17, at the Dental Department of the University of Tennessee, Memphis, for the purpose of examining all applicants who present credentials acceptable to the board. Hygienists will also be examined. Credentials are to be brought to the board meeting for examination by the entire board. Applications should be in the hands of the secretary five days before the board meeting. For application and clinical requirements, address

F. W. Meacham, *Sec'y-Treas.,*
911 Hamilton National Bank Bldg.,
Chattanooga

MONTANA STATE BOARD OF DENTAL EXAMINERS

The next meeting of the Montana State Board of Dental Examiners will be held,

July 8-12, at Helena. For further information, address

T. P. REGAN, *Secretary*,
Helena

ARKANSAS STATE BOARD OF DENTAL EXAMINERS

The Arkansas State Board of Dental Examiners will meet at 8 a. m., Monday, June 24, at the Marion Hotel, Little Rock, for the purpose of examining all applicants possessing the proper credentials. Applications should be in the hands of the secretary at least one week before the board meeting. For application blanks, clinical requirements, etc., address

FLOYD P. TRAVIS, *Sec'y-Treas.*,
Osceola

WYOMING STATE DENTAL ASSOCIATION

The annual meeting of the Wyoming State Dental Association will be held in Cheyenne, June 28-29.

E. C. ANDREW, *Secretary*,
Cheyenne

MISSISSIPPI STATE BOARD OF DENTAL EXAMINERS

The regular meeting of the Board of Dental Examiners for the State of Mississippi shall be held at the capital of the state on the third Tuesday in June of this year for the purpose of examining applicants for license to practice dentistry and dental hygiene. For further information, address

T. FORD LEGGETT, *Sec'y-Treas*,
Laurel

NEW MEXICO STATE DENTAL BOARD

The next meeting of the New Mexico State Dental Board will be held in Las Cruces, commencing June 13. For applications and other information concerning this meeting, address

J. J. CLARKE, *Secretary*,
Artesia

INTERNATIONAL DENTAL FEDERATION

The next meeting of the International Dental Federation will be held, August 5-11, in Utrecht, Holland.

BOARD OF DENTAL EXAMINERS OF THE DISTRICT OF COLUMBIA

The next meeting of the Board of Dental Examiners of the District of Columbia for the examination of dentists and dental hygienists will be held the week beginning June 17, at the Georgetown Dental School, 920 H Street, N. W. For application blank and instructions, address

C. WILLIARD CAMALIER, *Sec'y-Treas.*,
406 Medical Science Bldg.,
Washington

VIRGINIA STATE BOARD OF DENTAL EXAMINERS

The next regular meeting of the Virginia State Board of Dental Examiners will be held at the Medical College of Virginia, Richmond, beginning promptly at 9 a. m., June 11. Applicants are required to present a certificate from the state board of education showing that they have had one year of academic education equal to one year of college work. Applications, with fee and photograph, must be filed, complete, ten days before the examination date. For application blanks and further information, apply to

JOHN M. HUGHES, *Secretary*,
715 Medical Arts Bldg.,
Richmond

ILLINOIS STATE DENTAL SOCIETY

The annual meeting of the Illinois State Dental Society will be held in Springfield, May 14-16.

OKLAHOMA STATE BOARD OF DENTAL EXAMINERS

The next regular meeting of the Oklahoma State Board of Dental Examiners will be held, June 24, at the State Capitol Building, Oklahoma City. For application blanks, write to E. E. Sanger, Yukon.

CHARLES A. HESS, *Sec'y-Treas.*,
Idabel

EXAMINATION FOR APPOINTMENT TO DENTAL CORPS OF U. S. NAVY

A competitive examination for appointment to the Dental Corps of the United States Navy will begin July 8, 1929, at the U. S. Naval Medical School, Washington, D. C. Candidates must be citizens of the United States, between 21 and 32 years of

age at the time of appointment, and graduates of recognized dental schools. The examination will be both theoretical and clinical and the usual duration is about seven days. A circular containing full information relative to the Dental Corps and the prescribed form of application may be obtained from the Bureau of Medicine and Surgery, Navy Department, Washington, D. C. No allowance is made for the expense of applicants appearing for examination.

C. E. RIGGS
Surgeon-General, U. S. Navy

THE NORTH DAKOTA BOARD OF DENTAL EXAMINERS

The North Dakota Board of Dental Examiners will hold their next meeting, July 9-12, at the Gardner Hotel, Fargo. All applications must be in the hands of the secretary by June 30.

GILBERT MOSKAU, *Secretary*,
Northwestern Nat'l Bank Bldg.,
Grand Forks

SOUTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

The next meeting of the South Dakota Board of Dental Examiners will be held in Sioux Falls, at the Carpenter Hotel, Monday, June 24, beginning at 9 a. m.

G. G. KIMBALL, *Secretary*,
Mitchell

TEXAS STATE BOARD OF DENTAL EXAMINERS

The Texas State Board of Dental Examiners will hold its next examination at Baylor University Dental School, Dallas, June 18-21, inclusive. Applications, with photograph and fee of $25, and two letters of recommendation, must be in the hands of the secretary not later than June 1. For further information and application blanks, apply to

MAXWELL C. MURPHY, *Secretary*,
King's Daughters Hospital,
Temple

NORTH CAROLINA DENTAL SOCIETY

The North Carolina Dental Society will hold its next annual meeting at Wrightsville Beach, June 10-12.

DENNIS KEEL, *Sec'y-Treas.*,
Greensboro

DELAWARE STATE BOARD OF DENTAL EXAMINERS

The next meeting of the Delaware State Board of Dental Examiners will be held in the Municipal Building, Tenth and King streets, Wilmington, June 19-20, from 9 a. m. to 5 p. m. For further information, address

W. S. P. COMBS, *Secretary*,
Middletown

NORTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

The next regular meeting of the North Carolina State Board of Dental Examiners will be held in Raleigh, June 17-20. For further information and application blanks, address

H. L. KEITH, *Sec'y-Treas.*
409 Murchison Bldg.,
Wilmington

MISSOURI BOARD OF DENTAL EXAMINERS

The Missouri Board of Dental Examiners will hold an examination in Kansas City, June 5-8. All applications must be filed at the office of the secretary at least ten days before the date of examination. For full information, application blanks, etc., address

GEORGE E. HAIGH, *Secretary*,
Central Trust Bldg.,
Jefferson City

SOUTH DAKOTA STATE DENTAL SOCIETY

The South Dakota State Dental Society invites all members of the American Dental Association to its forty-seventh annual meeting, July 1-2, at Rapid City. Among the essayists on the program are T. W. Maves, Cleveland, Herman Maves, Minneapolis, and Sherman L. Davis, Indianapolis. We wish especially to invite the dentists to spend their vacation with us, to enjoy the wonderful climate and scenery of the Black Hills, the locale of the "Summer White House" of 1927. More than 600 miles of swift flowing mountain streams fed by winter snows and teeming with brook, lock laven, rainbow and speckled trout are found in this land of the jack pine, spruce, and cedar, the home of deer, elk, buffalo, mountain sheep and numerous smaller animals. July 3-5, the annual Black Hills Round-Up, one of the best known rodeos in the United States, will be held. In

addition, there will be a bull fight, with Brahms steers, matadors and toreadors from Mexico. We have in the Black Hills an area of 50 by 100 miles, with an elevation of from 4,000 to 7,000 feet, cool temperatures, excellent hard surfaced roads the entire distance from the east, and many summer resorts and log cabins available for visitors. If you wish a program of this meeting, with descriptive literature of the Black Hills of South Dakota, write to

ERNEST W. ELMEN, *Secretary*,
Sioux Falls

SUMMER COURSE FOR DENTAL HYGIENISTS

Conducted by Massachusetts Departments of Public Health and Education, Hyannis, Mass., July 1-August 10.

This course is open to graduate dental hygienists who are in public health work or who are planning to go into this field. A certificate similar to that given to school nurses will be awarded when the hygienists have completed six courses (five required and one elective). Tuition is free to all who live in Massachusetts and is $20 to those from other states. For all students attending the summer school, there will be an incidental fee of $5.

All courses offered are full courses, running one hour a day for the six weeks period. Required, first summer: school dental procedures, public health and teaching methods applied to health subjects; second summer: nutrition and psychology; electives: immigrant education, personal hygiene and biology.

Application cards may be obtained from Mrs. E. G. McCarthy, Massachusetts Department of Public Health, Boston.

POSTGRADUATE SUMMER SCHOOL FOR DENTAL HYGIENISTS

The fourth annual summer session of postgraduate study for dental hygienists will open at State Teachers College in Buffalo, July 1, and will continue through Friday, August 9. While this course is primarily designed for those wishing to qualify as dental hygiene teachers in New York State, the work presented should prove of value to any dental hygienist in her contacts with the public.

A parallel course for school nurses is also given. These courses have been approved by the state education department as meeting the requirements for certification as a dental hygiene teacher and school nurse teacher. Tuition is free to residents of New York State. Twenty-five dollars is charged nonresidents. Living expenses approximate from $10 to $15 a week. Classes are held five days a week, from July 1 to August 9.

Complete announcement of the course and applications for admission will be sent on request by S. R. Meaker, Supervisor of Oral Hygiene, State Education Department, Albany, N. Y.

NEW YORK UNIVERSITY COLLEGE OF DENTISTRY

SHORT POSTGRADUATE COURSES

Beginning on the dates specified, the following courses will be offered: ceramics, June 3; oral surgery I, June 3; oral surgery II, June 17; denture prosthesis, September 3; preventive dentistry, September 3; periodontia, September 3; pulp canal therapy, September 3; also longer courses in oral surgery and orthodontia beginning October 1.

By special arrangement, most of the courses listed may be taken on either a full-time or a part-time basis, thus providing for the fullest utilization of time by those living at a distance and for the continuance of part-time practice during the period of the course for those living in or near New York.

The graduate faculty includes: Milo Hellman, D.D.S., Thaddeus P. Hyatt, D.D.S., John Oppie McCall, D.D.S., Gustave Noback, Ph.D., William H. Park, M.D., Clyde H. Schuyler, D. D. S., Victor H. Sears, D.D.S., Harold D. Senior, M.D., Frederick L. Stanton, D.D.S., Paul R. Stillman, D.D.S., Alfred Walker, D.D.S., Leo Winter, D.D.S.

For further information address:

W. H. O. MCGEHEE, *Secretary*
New York University College of Dentistry
209 East 23rd Street,
New York City

CORRECTION

In the article on "Ora-Noid," in the March issue, the word "iron" in the fifth line of the last paragraph on page 555 should be "ion."

HOTELS	Rooms	Single with Bath	Double with Bath	Single without Bath	Double without Bath
BLACKSTONE 17th St., Btw. K. & L.	100	$3.00-5.00	$5.00-6.00		
BURLINGTON Vermont Ave. Thomas Circle	200	3.00-4.00	5.00-7.00	$2.50	$4.00
CAPITOL PARK N. Capitol & E.	150	3.00-4.00	4.00-6.00	2.00 up	3.00 up
CARLTON 16th & K. St.	260	5.00-7.00	8.00-12.00		
COMMODORE N. Capitol & F.	154	2.50-3.50	4.50-6.00		
CONTINENTAL N. Capitol & E.	250	3.00-4.00	5.00-7.00	2.00-2.50	3.00-4.00
DRISCOLL 1st & B. Sts.	200	3.50	6.00	2.00 up	3.00 up
EBBITT 1000 H. St.	150	2.50-3.00	4.00-5.00		
GRACE DODGE N. Capitol & E.	300	3.00-4.00	5.00-8.00	2.50-3.00	4.00 5.00
GRAFTON Conn. Ave., Btw. L. & N.	125	3.50-6.00	5.00-8.00	2.50-3.50	4.00-5.00
HARRINGTON 11th & E.	300	2.50-5.00	5.00-8.00	2.50 up	3.50-5.00
LAFAYETTE 16th & Eye Sts.	200	4.00-6.00	6.00-8.00		
MAYFLOWER Connecticut Ave.	650	5.00-10.00	7.00-15.00		
METROPOLITAN 6th & Pa. Ave.	175	2.50	4.00 up	1.50 up	3.00 up
POWHATAN Pa. Ave. & 18th	300	3.00-5.00	6.00-9.00		
RALEIGH 12th & Pa. Ave.	460	4.00-6.00	5.00-10.00	3.00-4.00	4.00-6.00
WARDMAN PARK Conn. Ave. & Woodley	400	uniform rate $5.00	uniform rate $8.00		
WASHINGTON Pa. Ave. & 15th	400	5.00-8.00	8.00-12.00		
WILLARD Pa. Ave. & 14th	475	5.00-10.00	7.00-15.00		
WINSTON 1st & Pa. Ave.	100	2.50 up	4.00 up	1.50 up	3.00 up

AMERICAN DENTAL ASSOCIATION

Washington, D. C. October 7-11, 1929.

HOTEL RESERVATIONS

In securing hotel reservations for the 1929 Session, consult the hotel rate-sheet and fill out the blank application below. Mail immediately to the hotel you wish to patronize. The hotel will then advise you of the reservation which they make for you.

In case your first choice cannot be made, indicate second and third choices. If none of your choices are available, the hotel manager will mail your application to the Chairman of the Halls and Hotels Committee and he will place your reservation in as favorable a hotel as possible.

Please remember that a reservation constitutes a contract with the hotel to provide you with the accommodations you desire. If you find it impossible to carry out your part of the contract, namely to occupy the room at time agreed on, please write or wire the hotel releasing it, in order that your room may be available for other members.

MAIL THIS APPLICATION DIRECT TO THE HOTEL

HOTEL RESERVATION

AMERICAN DENTAL ASSOCIATION, WASHINGTON, D. C., OCT. 7-11, 1929

.....Hotel. .....1929.
Washington, D. C.

Please reserve sleeping room accommodations as noted below:

.....room(s) with bath for .....people. Rate desired per day $.....

.....room(s) without bath for.....people. Rate desired per day $.....

Second choice hotel.....

Third choice hotel.....

ROOMS TO BE OCCUPIED BY: ADDRESS IN FULL

Applicant..... .....

....

....

....

Please confirm this reservation to applicant. I further agree to notify the hotel at once in the event I am unable to use this reservation.

Important to Hotel Manager: In the event you cannot accept this reservation, please forward this application at once to Dr. R. L. Morrison, Chairman Halls and Hotels Committee, Suite 706, 1103 Vermont Ave., N. W., Washington, D. C., who will attend to the assignment of this reservation.

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1929

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